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EXPLORATIONS IN CENTRAL ASIA, 1906-8.*

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I might talk for hours about the strange observations and experiences which, in the course of those fascinating months spent along the ancient Chinese frontier wall in the desert, made me forget, as it were, the lapse of long ages. A few touches must suffice here. Never did I realize more deeply how little two thousand years mean where human activity is suspended, and even that of nature benumbed, than when, on my long reconnoitring rides, the evenings found me alone amidst the *débris* of some commanding watch-station. Struck by the rays of the setting sun, tower after tower far away, up to 10 miles' distance and more, could be seen glittering in a yellowish light. As they showed up from afar, with long stretches of the wall between them, often clearly rising as straight brownish lines above the grey bare gravel desert, how easy it was to imagine that towers and wall were still guarded, that watchful eyes were scanning the deceptive plateaus and nullahs northward! The arrow-heads in bronze which I picked up in numbers near the wall and towers, were clear proof that attacks and alarms were familiar incidents on this border. Unconsciously my eye sought the scrub-covered ground flanking the salt marshes where Hun raiders might collect before making their rush in the twilight.

But the slanting rays of the sun would reveal also things far more real. Then the eye caught quite clearly a curiously straight, furrow-like line keeping parallel to the wall, and about 20 feet within it, wherever there was a well-preserved stretch of it. Repeated examination proved that it was a shallow but well-defined track worn into the fine gravel soil by the patrols and others who had tramped along here for centuries. In spite of the persistence with which this strange

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uncanny track reappeared along wall sections situated miles away from the caravan route, I might have doubted this simple explanation had I not again and again had occasion to convince myself of the remarkable persistence with which this gravel soil retains and preserves all impressions. Thus, the footprints we had left on our first march to Tun-huang, looked two months later absolutely as fresh as if we had just passed there. Yet we knew by sad experience the force of the gales which had blown here almost daily.

I may quote another curious observation in illustration of the extraordinary preserving power of this desert soil and climate. At a number of watch-stations I had noticed a series of queer little mounds, arranged in regular cross rows (*quincunx* fashion), each about 7 feet square and about 6 feet in height. Closer examination revealed that they were built up entirely of regular reed fascines, laid crosswise in alternate layers, and intermixed with a slight sprinkling of coarse sand and gravel. Through the action of the salts once contained in them, the reeds had acquired a quasi-petrified appearance and considerable consistency, though each reed, when detached, still showed flexible fibres. I was at first greatly puzzled as to the real meaning and purpose of these strange little structures until it dawned upon me, in consequence of various conclusive observations, that they were nothing but stacks of the reed fascines, such as used in the construction of the *agger*, kept ready at the posts for any urgent repairs. Of course, they at once reminded me then of the stacks of wooden sleepers seen neatly piled up at a railway station.

I cannot touch here upon the various questions of physical conditions and changes regarding which this border-line, drawn through the desert more than twenty centuries ago, serves for us as an accurate historical gauge. Its value for this purpose is greatly increased by the fact that the ground it traverses has remained wholly untouched by the manifold and often complex factors connected with human activity. To the important evidence which the remains of the wall supply as to the winds prevailing since two thousand years I have already alluded.

We suffered a great deal from the almost daily gales and the extremes of the desert climate. Against the icy blasts which continued well into April our stoutest furs were poor protection. On April 1, 1907, I still registered a minimum temperature of 39° below freezing-point. But before the month was ended the heat and glare had already become very trying (on April 20 the thermometer showed 90° Fahr. in the shade), and whenever the wind fell, perfect clouds of mosquitoes and other insects would issue from the salt marshes, near which we had to camp for the sake of water, to torment men and beasts. For weeks I had to wear a motor-veil day and night to protect myself. Even the wild camels, which we frequently sighted, must dread these pests; for we found their fresh resting-places out on the absolutely bare gravel plateaus far away

FIG. 12.—SOUTHERN SERIES OF CAVE TEMPLES AT THE "HALLS OF THE THOUSAND BUDDHAS."

from the grazing. Another source of trouble was the saltiness of the water, even in the springs of the marshes. When the excavations had been completed, by the middle of May, it was high time to return to the oasis. That under such conditions we managed to keep to the last our Chinese labourers at work, all opium-smokers, and of great *vis inertiæ*, like most of the people of Tun-huang, seemed a wonder, due largely to the unfailing tact and good nature of my invaluable Chinese secretary and helpmate.

An important archæological task made me doubly eager to return to Tun-huang. In 1902, my friend, Prof. L. de Lóczy, the distinguished head of the Hungarian Geological Survey, and President of the Geographical Society of Hungary, had called my attention to the sacred Buddhist grottoes, known as the 'Halls of the Thousand Buddhas,' to the south-east of Tun-huang, which, as member of Count Széchenyi's expedition and thus as a pioneer of modern geographical exploration in Kan-su, he had visited as early as 1879. His glowing description of the fine fresco paintings and stucco sculptures which he had seen there and the archæological importance of which he had quite rightly recognized, without himself being an antiquarian student, had then greatly impressed me, and had been a main cause inducing me to extend the plans of my expedition so far eastwards into China.

When, soon after my arrival at Tun-huang, in March, 1907, I had paid my first flying visit to the sacred caves carved into the precipitous conglomerate cliffs at the mouth of a barren valley some 12 miles to the south-east of the oasis (Fig. 12), I had found my expectations fully verified, and now I was drawn back by the remembrance of a wealth of art treasures waiting for closer study. There were hundreds of grottoes, large and small, honeycombing in irregular tiers the sombre rock-faces, and my first hurried inspection showed that almost all of them had on their plastered walls a profusion of beautiful and more or less well-preserved frescoes. In composition and style they showed the closest affinity to the remains of Buddhist pictorial art as transplanted from India to Eastern Turkestan, and already familiar to me from the ruined shrines I had excavated in the Khotan desert. The sculptural remains in these grottoes were equally plentiful, and bore equally interesting testimony to that early art connection between India and China proper; but much of this statuary in friable stucco had evidently suffered both from the hands of iconoclasts—and the zeal of pious restorers (Fig. 13).

Plentiful antiquarian evidence, including a series of fine Chinese inscriptions on marble, proved beyond all doubt that a very great portion of the shrines and art relics belonged to the period of the T'ang dynasty (seventh to ninth century A.D.), when Buddhism had greatly flourished in China and when for nearly two centuries this westernmost outpost of China proper had enjoyed imperial protection against invasions, both from the Turks in the north and the Tibetans southward. The

vicissitudes of the succeeding period, when, until the establishment of paramount Mongol power, these Marches, then already outside the 'Great Wall,' had been abandoned to barbarian inroads of all sorts, must have sadly diminished the splendour of the temples and the numbers of the monks and nuns established near them. Yet, in spite of all changes and devastations, Tun-huang had evidently managed to retain its traditions of Buddhist piety even then; for as I examined one grotto after the other, noting the profusion of large images on their platforms, and the frequency of colossal figures of Buddhas in a variety of poses, I felt convinced that it was the very sight of these colossal statues, some reaching nearly 100 feet in height, and the vivid first impression of the cult paid to them, which had made Marco Polo put into his chapter on *Sa-chui*, *i.e.* Tun-huang, a long account of the strange idolatrous customs of the 'people of Tangut.'

The good folk of Tun-huang have, indeed, remained to this day attached with particular zeal to such forms of worship as represent Buddhism in the queer medley of Chinese popular religion, and it scarcely needed the experience of a great annual religious fair which drew the villagers and townspeople of the oasis by the thousands to the 'Thousand Buddhas' just about the time of my return, to make it clear to me that the cave temples, notwithstanding all apparent decay, were still real cult places "in being." I knew well, therefore, that my archæological activity at them, as far as frescoes and sculptures were concerned, would, by every consideration of prudence, have to be strictly platonic, *i.e.* to remain confined to the study of the art relics by means of photography, drawing of plans, etc.; in short, to such work as could not reasonably arouse popular resentment with all its eventual risks.

Yet when by May 20, 1907, I established myself for a prolonged stay in camp at the sacred site which then had once more resumed its air of utter desolation and silence, I confess what kept my heart buoyant were secret hopes of another and more substantial kind. Two months before I had heard vague rumours about a great hidden deposit of ancient manuscripts, which had been accidentally discovered by a Taoist monk about two years earlier, while restoring one of the temples. The trove was jealously guarded in the walled-up side chapel, where it was originally discovered, and there were good reasons for caution in the first endeavours to secure access to it.

The Taoist priest who had come upon and taken charge of it, proved a very quaint person, as ignorant of what he was guarding as he was full of fears concerning gods and men. He was at first a difficult person to handle, and the story of our lengthy struggle with his objections, conscientious and otherwise, must be left to be told hereafter. But I may confide here that our success in the end was, apart from Chiang-ssŭ-yieh's tactful diplomacy, due mainly to what the priest was prepared to accept as a special interposition on my

behalf of my Chinese patron saint, the great Hsüan-tsang. Already the fact of my well-known attachment to the memory of the saintly traveller had been helpful; for curiously enough the Tao-shih, though poorly versed in, and indifferent to, things Buddhist, was quite as ardent an admirer in his own way of 'T'ang-sêng,' the "great monk of the T'ang period," as I am in another. It is true the fantastic legends which have transformed Hsüan-tsang in popular belief into a sort of saintly Münchhausen, and which accounted for the Tao-shih's worship, are not to be found in the great pilgrim's genuine Memoirs. But why should that little difference matter? When the first specimens which we at last prevailed upon the priest to pick up from the hidden manuscript store and show us in secret, proved by mere chance to be fine rolls of paper containing Chinese versions of certain Buddhist texts, which the colophons declared to have been brought from India and translated by Hsüan-tsang, the priest and even my zealous secretary were greatly impressed by the portent. Was it not Hsüan-tsang himself, so the latter declared, who had at the opportune moment revealed the hiding-place of that manuscript hoard in order to prepare for me, his disciple from distant India, a fitting antiquarian reward on the western-most confines of China proper?

Under the influence of this quasi-divine hint the Tao-shih then summoned up courage to open before me the rough door closing the entrance which led from the side of the broad front passage of his temple into the rock-carved recess, and which, previous to accidental discovery through a crack, had been hidden behind a frescoed wall. The sight of the small room disclosed was one to make my eyes open wide. Heaped up in layers, but without any order, there appeared in the dim light of the priest's little oil lamp a solid mass of manuscript bundles rising to 10 feet from the floor and filling, as subsequent measurement showed, close on 500 cubic feet. It was impossible to examine anything in this "black hole." But when the priest had brought out some bundles, and had allowed us to look rapidly through the contents in a side room of the newly built porch, where we were well screened from any inquisitive eyes, my contentment rose greatly.

The thick rolls of paper, about one foot high, which turned up first, contained Chinese Buddhist texts in excellent preservation, and yet showing in paper, arrangement, etc., unmistakable signs of great age. To discover exactly dated records in these big rolls opening out to 10 yards' length and more was not easy at first. But when I lighted on the reverse of a Chinese roll upon an extensive text in a cursive form of Indian Brahmi script, I felt relieved of all doubt. Here was indisputable proof that the bulk of the manuscripts deposited went back to the time when Indian writing and some knowledge of Sanskrit still prevailed in Central-Asian Buddhism. All the manuscripts were manifestly preserved exactly in the same condition they were in, when

deposited. Nowhere could I trace the slightest effect of moisture. And, in fact, what better place for preserving such relics could well be imagined than a chamber carved out of the rock in these terribly barren hills, and hermetically shut off from what moisture, if any, the atmosphere of this desert valley ever contained?

How grateful I felt for the protection thus afforded when, on opening a large packet wrapped in a sheet of stout coloured cotton, I found it full of fine paintings on silk and cotton, ex-votos in all kinds of silk and brocade, with a miscellaneous mass of paper pictures, streamers in various fabrics, fragments of embroidered materials, etc. The silk and cotton paintings had served as temple banners, and were found neatly rolled up. When unfurled they displayed beautifully painted figures of Buddhas and Bodhisattvas, either quite Indian in style, or else illustrating in a very interesting fashion the adaptation of Indian models to Chinese taste. Below the divine figures or scenes there appear frequently representations of worshippers, in the characteristic monastic dress of the period. And it was not long before Chiang-ssŭ-yieh had discovered dedicatory legends, with dates of the ninth and tenth century A.D. The silk used for these paintings was almost invariably a transparent gauze of remarkable fineness. Hence, when we came upon larger pictures of this sort, up to 5 or 6 feet in length, closely folded up at the time of their deposition, and much creased in consequence, the opening out of them could not be attempted from obvious risks of damage. Nor was there time then for any closer study. My main care was how many of these delicate graceful paintings I might hope to rescue from their dismal imprisonment and the risks attending their present guardian's careless handling. To my surprise and relief, he attached little value to these fine art relics of the T'ang times. So I could rapidly put aside "for further inspection" the best of the pictures, without the risk of displaying too great *empressement*.

It was probably the priest's indifference to remains of this kind, and his secret hope of diverting by their sacrifice my attention from the precious rolls of Chinese canonical texts, which made him hand out now more readily bundles of what he evidently classed under the head of miscellaneous rubbish. I had every reason to be satisfied with this benevolent intention; for in the very first large packet of this sort I discovered, mixed up with Chinese and Tibetan texts, a great heap of leaves in the variety of Indian script, known as Central-Asian Brahmi. They proved on arrangement to belong to half a dozen different MSS., several of considerable size and some quite complete. None of my previous finds in Sanskrit or the "unknown" ecclesiastical language of Turkestan written in this script equalled them in this respect or in excellence of preservation. So Chiang-ssŭ-yieh and myself worked on without a break that first day until it got quite late, picking out sometimes stray Indian leaves even from regular Chinese or Tibetan bundles,

or else Chinese texts with Central-Asian versions and notes. Though our honest Tao-shih grew visibly tired with climbing over MS. heaps and dragging out heavy bundles, I could see that our appreciation of all this, to him valueless, lore flattered and reassured him.

It is impossible for me to describe here how the search was continued day after day without remission, or to indicate all the interesting finds with which this curious digging was rewarded. It was particularly the bundles filled with miscellaneous texts, painted fabrics, papers of all sorts, which yielded such finds in plenty. One of the most important among them was a large and remarkably well-preserved Sanskrit MS. on palm-leaves, apparently containing some text from the northern Buddhist Canon. The material makes it quite certain that the MS. had been brought from India, and palæographical features indicate its having been written earlier than any so far known Sanskrit MS. Tibetan texts, both in form of big rolls and Pothis, were abundant. But not from the south alone had the old temple library, which had lain hidden here for long centuries, received its additions. Considering how flourishing Buddhism was under the Uighur kingdom, which existed in the north-east of Turkestan up to the twelfth century, and at one time probably also held Tun-huang, I was not surprised when Uighur MSS. cropped up in various miscellaneous bundles. Kök-turki, too, and even the peculiar form of Syriac script, usually employed for Manichæan writings, were represented.

Less attractive at first sight but in reality of particular antiquarian value were the miscellaneous records in Chinese, such as letters, monastic accounts, etc., which filled those bundles of apparent "waste paper." They not only throw instructive light on monastic organization as prevailing here in the ninth to tenth century, but the plentiful dated documents found among them soon enabled me to determine that the walling-up of the chamber must have taken place soon after 1000 A.D. There can be little doubt that the fear of some destructive invasion had prompted the act. But the well-sheltered small cave had in all probability served for a long time previously as a place of deposit for all kinds of objects sanctified by their use but no longer needed. That these objects must have been very often of considerable antiquity already at the time when the deposit was finally walled up, was obvious from the first. Yet it was to me a most gratifying assurance when the partial examination of our Chinese collection which became possible a year later, disclosed in fact among it quite a series of manuscripts showing exact dates which extend certainly as far back as the third century A.D. But it will yet need protracted scholarly labours before the time of the earliest pieces can be definitely established.

When long days of anxious work had resulted in the rapid search of all miscellaneous bundles piled up on the top and the selection of all manuscripts of special interest, pictures, and other relics I was

eager to rescue, we attacked the solid rampart of hard-tied uniform packets of Chinese manuscript rolls. This was a troublesome undertaking in more than one sense, though discreet treatment and judiciously administered doses of silver did much to counteract the Tao-shih's relapses into timorous contrariness. The labour of clearing out the whole chamber might by itself have dismayed a stouter heart than his. However, in the end, it was amply rewarded by the discovery, quite at the bottom, of more miscellaneous bundles with to us precious silk paintings, etc. Rapid as our search of the rest had to be, it led also to the recovery of more manuscripts in Central-Asian Brahmi and other foreign scripts which had got embedded among the great array of Chinese rolls. The negotiations about the compensation to be offered to the Tao-shih in the form of a liberal present to the temple, which by his restoration he could claim to have annexed as his own with all its contents known or unknown, were necessarily protracted. But by that time most of the "selections for closer study," as our polite convention styled them, had already been safely transferred to my improvised store-room without any one, even of my own men, having received the slightest inkling.

How this was accomplished, mainly through Chiang's devotion, and how our acquisitions were safely packed without arousing any attention, is "another story." When the Tao-shih had received a weighty proof of our fair dealing in the form of a goodly number of silver ingots or "horseshoes," and had by a temporary visit to the oasis gathered assurance that his spiritual influence, such as it was, had suffered no diminution, he became almost ready to recognize that I was performing a pious act in rescuing for Western scholarship all those relics of ancient Buddhist literature and art which were otherwise bound to get lost earlier or later through local indifference. I received gratifying proof of the peaceful state of his mind when on my return four months later he agreed to let depart for a certain seat of learning in the distant West a fair share also of the Chinese and Tibetan manuscripts. But my time for feeling true relief came when all the twenty-four cases, heavy with the manuscript treasures rescued from that strange place of hiding, and the five more filled with paintings, embroideries and similar art relics from the same cave, had safely been deposited in London.

The strain of these labours had been great. So, when by the middle of June I had completed also the examination and photographing of all the more notable frescoes and sculptures of old date in the "Halls of the Thousand Buddhas," I was heartily glad to exchange archæological work in the torrid desert plains for geographical exploration in the western and central Nan-shan. After leaving my collections in the safe keeping of the Yamên at An-hsi, I moved towards the great snowy range south, which forms the watershed between the Su-lai-ho and the river of Tun-huang. On my way there I discovered a large ruined site

FIG. 13.—CAVE TEMPLES WITH FRESCOES AND SCULPTURE AT THE "HALLS OF THE THOUSAND BUDDHAS," SOUTH-EAST OF TUN-HUANG.

FIG. 14.—FRESCOED WALL IN CAVE TEMPLE AT "THE TEN-THOUSAND BUDDHAS."

near the village of Chiao-tzŭ, between the lowest two of the barren outer ranges. The great change in physical and economic conditions which desiccation has worked in this lower hill region, was illustrated by the fact that the stream from which a canal still traceable for a long distance brought water to the town and the once cultivated area around it has completely disappeared.

Though the damage done by extensive erosion and the height of the dunes left little scope for excavation, yet enough archæological evidence was secured to show that the walled town must have been occupied up to the twelfth to thirteenth century A.D. All the more striking was the proof which its walls afforded of the effects of wind erosion since that period. In spite of very massive construction all lines of walls facing east have been completely breached through the driving and scouring sand, and in many places practically effaced, while the walls facing north and south and thus lying parallel to the direction of the prevailing east winds, have escaped practically uninjured. When I subsequently ascended the cañon-like valley in which the stream of Ta-hsi cuts through the second outer range, I came upon a very picturesque series of Buddhist cave temples, known as *Wang-fu-hsia* ("Valley of the Ten-thousand Buddhas") and still forming a pilgrimage place. In character and date they showed close affinity to the "Halls of the Thousand Buddhas." The large and well-preserved fresco compositions decorating their walls furnished fresh illustrations of value for the study of Buddhist pictorial art as practised in this region from the eighth to the twelfth century A.D (Fig. 14).

After surveying the great chain of glacier-crowned peaks which overlook the terribly barren detribus plateaus of the Nan-shan west of the Su-lai-ho, we descended to the pleasant little oasis of Chong-ma. Then crossing the river there we made our way through a hitherto unexplored mountain tract where even at this favourable season want of water was a serious difficulty, to the famous Chia-yü-kuan Gate of the still extant Great Wall. Here I succeeded in clearing up an archæological problem of considerable historical interest. All books and maps, whether European or Chinese, represent the imposing line of wall which bends round the westernmost part of the Su-chou oasis to the very foot of the Nan-shan, as the termination of the ancient Great Wall protecting the northern border of Kan-su. Since centuries the big fortified gate leading through it has been greeted by travellers coming from Central-Asia as the threshold of true Cathay. Yet certain early Chinese records seemed to place the position of that famous gate much further to the west, and the remains of the ancient frontier wall I had discovered in the desert of Tun-huang spoke still more emphatically against that assumption. Careful examination on the spot sufficed to solve the problem. I was able to trace near Chia-yü-kuan the junction of two defensive lines of widely different age and purpose. One line

represented by the crumbling wall of stamped clay which runs along the whole northern border of the Su-chou and Kan-chou districts, proved to have been originally connected with the *limes* of Tun-huang and An-hsi and to date like this from the second century B.C. Its purpose was to protect the narrow belt of oases along the north foot of the Nan-shan which since Chinese expansion westwards had commenced under the first Han dynasty, was indispensably needed as a passage into Eastern Turkestan. The second line, which meets this ancient wall at right angles and through which one now passes by the Chia-yü-kuan gate, is of far more recent construction and was built for the very opposite purpose, that of closing the great Central Asian route at a time when China had resumed its traditional attitude of seclusion.

At Su-chou, the first town within the wall, I had to overcome considerable difficulties before we could start by the close of July on our expedition into the Central Nan-shan. The local authorities, though just as well disposed as I always found them elsewhere, were full of apprehensions about attacks of Tangut robbers, etc., and even when they had reluctantly resigned themselves to my going, the collection of the necessary transport still proved a very difficult task. The Chinese settlers of the Kan-su oases are swayed by a perfect dread of the mountains, which to them remain a *terra incognita* beyond the outermost range, and the men with hired ponies whom the well-meaning magistrate of Su-chou succeeded at last in raising, *recte* pressing, for our service, would no doubt never have started but for a firm hope of forcing us soon into an early return. We could obtain guides only as far as the broad plateau-like valley between the Richthofen and Tolai-shan ranges, where we found gold-pits at an elevation of circ. 13,000 feet worked by small parties of more venturesome people from the Hsi-ning side.

After leaving these exposed mining camps, where the snow had just melted, we did not sight human beings until towards the close of the month we came upon a few Mongols grazing in the valleys south of Kan-chou. Fortunately the well-defined character of the four great ranges in which the Nan-shan rises towards the uplands of the Khara-nor and Koko-nor region (Fig. 15), and the open nature of the main valleys between them, proved a great advantage for systematic survey work and made the want of all guidance less serious. The excellent grazing met with almost everywhere at elevations between 11,000 to 13,000 feet was a great boon for our hard-tried animals, and saved us from all serious losses. But the relatively abundant moisture of which it is the result, and which makes the contrast so striking to the barren slopes of rock and detritus presented by the Western Nan-shan, made itself felt also in a less pleasant way. We all suffered a great deal from almost daily downpours of icy rain and sleet, and the trouble arising from the extensive bogs we encountered at the head of the great valleys and even on the broad watershed plateaus.

The natural difficulties unavoidable in such inhospitable solitudes were increased very considerably by the helplessness of our Chinese ponymen and what I may politely call their deep-rooted physical aversion from taking risks. Now, these dreaded mountains were to them full of risks, imaginary as well as real, and instead of using such intelligence as plentiful opium smoking had left them to guard against these, they tried their best to run away from them altogether. Again and again they made organized attempts at desertion which threatened to leave us without transport, but luckily could be suppressed without frustrating our plans. Chiang-ssŭ-yieh and myself used to talk of them as our "senile babies." They saw risks everywhere, like aged men worn out by much hard experience, yet were like babes in a wood when it came to obviating any of them. They, as well as the small party of Chinese soldiers whom the Su-chou authorities had insisted upon sending along as an escort, were, owing to their own improvidence, soon threatened by starvation. Luckily we managed to ward this off by using for them rations of the barley which could somehow be spared from the ponies. But Chiang had bravely to set an example in eating it himself before they took to this unorthodox food-stuff. Then a few wild donkeys we managed to shoot came to the rescue.

By marches aggregating to over 400 miles, we managed during August to cross and survey in detail the three northernmost ranges of the Central Nan-shan, all rising to snowy peaks of 18,000 to 19,000 feet, between the longitudes of Su-chou and Kan-chou. In the course of these surveys all rivers descending to the oases as well as the Su-lai-ho were explored to their glacier-fed sources. Wherever it was possible we made for routes and passes different from those taken by the Russian explorers, MM. Obrucheff and Kozloff, who had first traversed parts of this mountain region. The magnificent ice-crowned range which divides the headwaters of the Su-lai-ho from the Khara-nor and Koko-nor drainage, was surveyed along its north face, and proved to rise both in height of individual peaks and of crest-line considerably above the northern ranges. From the wide mountain-girt basin some 13,000 feet high, where the Su-lai-ho gathers its main sources amidst a curious combination of marshes and drift-sand areas, we made our way over bog-covered uplands to the headwaters of the Ta-t'ung river, the northernmost large tributary of the Hoang-ho, where we touched the Pacific drainage. Thence we regained the upper valley of the Kan-chou river, and finally effected our passage through the Richthofen range over a succession of high transverse spurs. The flooded streams in the deep-cut tortuous valleys separating the latter gave much trouble. But for this I felt amply compensated by the sight of the luxuriant forest, mostly firs, which here clothes the mountain slopes, a delightful contrast to the barren wastes of rock, detritus or ice presented by the Western Nan-shan. The total mountain area covered by Ram Singh's

plane-table survey between An-hsi and Kan-chou amounted to close on 24,000 square miles.

From Kan-chou I started early in September on the long journey which was to take me back to the Tarim basin for my second winter campaign. Several considerations, archæological as well as practical, obliged me to follow on this journey the great caravan route *viâ* Hami and Turfan, which since the seventh century A.D. has supplanted the more ancient route past Lop-nor. While travelling along it to An-hsi I was able by a series of reconnaissances pushed northward, not only to survey that portion of the Great Wall which in a general way was known to flank the route as far as Chia-yü-kuan, but also to trace remains conclusively proving its earlier extension to An-hsi, as my explorations of the spring and early summer had led me to assume from the first. At An-hsi, Rai Ram Singh, who had rendered very valuable services in the Nan-shan, but whose health had proved unequal to the hardships of a second winter campaign in the desert, left me to regain India *viâ* Khotan. Advantage was taken of his journey to get also the more circuitous mountain route leading from Tun-huang to Charklik accurately surveyed. He was relieved by Surveyor Rai Lal Singh, who subsequently gave splendid proofs of exceptional zeal and fitness for surveying work under trying conditions, as tested before by many an expedition from Yemen to Eastern China.

Of the long journey commenced early in October, 1907, and covering close on 900 miles marching distance, which took me within about two months from An-hsi to Kara-shahr, in the extreme north-east of the Tarim basin, I cannot pause to give details here. Both at Hami and Turfan, the only oases breaking the monotonous stony waste between the Tien-shan and the Pei-shan, I devoted some time to visits of important ruined sites, though a variety of considerations precluded archæological operations on any scale. Advantage was also taken of these breaks for detailed surveys of those districts and the adjoining parts of the Tien-shan. At Turfan the inspection of the numerous and extensive ruins, dating chiefly from the time of the Uighur dominion (ninth to twelfth century A.D.), which had been largely explored by successive expeditions of Prof. Grünwedel and Dr. Von Lecoq, under the auspices of the Prussian Government, and had yielded a rich harvest, proved very instructive. To me it was interesting also to study the conditions which accounted for the survival of these ruins within or else quite close to the still cultivated area, particularly as I could well, after my desert experiences, appreciate the practical facilities thus assured to the archæologist.

On reaching Kara-shahr early in December, I lost no time in setting the spade to work. Sites of ancient towns of some size could be traced at several points of the great scrub-covered plain which encircles the northern shores of the Bagrash lake. But the vicinity of subsoil water,

often impregnated with salts, and the effects of a climate evidently less dry than in other parts of the great Turkestan basin, had completely destroyed all structural remains, and reduced even the clay-built town walls to mere shapeless earth mounds.

A far better field for systematic excavations was offered by an extensive collection of ruined Buddhist shrines, known to the local Muhammadans by the name of Ming-oi, "the Thousand Houses," which dot some low rock terraces jutting out from the foot of the hills, one march to the west of Kara-shahr. The disposition of the ruins in long rows of detached *cellas*, varying in size, but all similar in plan and construction, facilitated the employment of a large number of labourers. It soon became evident that, apart from the destructive effects of rain and snow, the temples had suffered much damage by a great conflagration, which, in view of coin finds reaching down to the ninth century A.D., is likely to have been connected with the earliest Muhammadan invasions. But in spite of all the destruction due to iconoclastic zeal and atmospheric influences, plentiful archæological spoil rewarded our systematic clearing. The deep *débris* layers filling the interior of the larger shrines yielded a great quantity of excellent relievo sculptures in stucco, once adorning the temple walls. From vaulted passages enclosing some *cellas* we recovered fine fresco panels which a timely burial had saved both from fire and moisture. Of the lavish adornment with votive gifts which these shrines once enjoyed, there survived evidence in finds of painted panels and delicately carved relievos once richly gilt. The style of these art relics displayed quite as clearly as the work of ancient Khotan, the predominant influence of Græco-Buddhist models brought from the extreme north-west of India. The frequency with which cinerary urns and boxes turned up around some of the shrines was a curious feature of the site; but of traces of the abodes of the living there were none. Was the great plain stretching eastwards already in old days that desolate waste of sand and scrub which it is now, notwithstanding the relative ease with which it could be brought under irrigation by canals from the large Kara-shahr river?

During the fortnight spent at Ming-oi we worked under quite Sarmatic conditions. Minimum temperatures down to 42° below freezing-point I should, perhaps, not have minded so much, had we only been saved those icy vapours sent forth by the great Bagrash lake south, which enveloped ruins and camp like a white fog, and did not lift for days. So it was a great relief for us all when the completion of my tasks just by Christmas allowed us to move up to the cold but sunny mountains of Khora, where information elicited with much trouble from reticent Mongol shepherds led to the discovery of Buddhist remains hitherto unnoticed. Lal Singh had rejoined me at Ming-oi after making his way from Turfan to Korla, mainly by previously unmapped routes through the barren ranges of the

Kuruk-tagh. He now used the opportunity for useful surveys on the range dividing the Kara-shahr valley from the great Turkestan plains, while I myself was clearing the ruined shrines, small but once richly decorated. Their picturesque seclusion had, alas! not saved them from the fury of iconoclast invaders.

The New Year of 1908 found us at Korla, where, close to the north-east end of the great sandy desert, I felt the satisfaction of having returned once more to my own ground. This old fascination of the Taklamakan induced me to test the firmly maintained reports which Korla hunters presented about "sand-buried towns," etc., they declared to have seen. The short expedition into the unsurveyed desert belt between the Inchike and Charchak river-beds was interesting enough geographically, showing in typical form the changes brought about by shifting river courses and general desiccation. But it revealed in the end that those elaborate reports had no more substantial foundation than the existence of early Muhammadan tombs and of rude shepherd huts amidst the dead jungle of earlier river-beds. Of course, my *soi-disant* guides were quite *bona fide* in their own way, and genuinely sorry that my supposed magic had not been powerful enough to overcome the evil genii hiding the walled towns, etc., which their own imagination had let them see before—apparently in a duststorm! They had honestly hoped that I with my "Wilayet arts" would secure them a chance of discovering all those hidden treasures of gold, etc.

On the Inchike Darya Lal Singh and myself separated and made our way by different routes through unsurveyed desert to the ancient oasis of Kuchar on the great caravan route north-westward. There I utilized a week's halt for visits to the interesting ruins close by, which had during the last five years been searched by successive Japanese, German, and Russian archæological parties, and had finally been cleared with remarkable thoroughness and method by the recent French Mission under Professor Pelliot. After this rapid survey I was free towards the close of January to resume my journey towards the south of the great desert. Inquiries set on foot by me since leaving the Khotan and Keriya region in 1906 had resulted in information reaching me about several ruined sites in the Taklamakan which had remained unexplored, and I was anxious to visit them before the heat and sand-storms of the spring made work on that ground impossible. A march due south from Kuchar through the Taklamakan to where the Keriya river dies away in the sands, was beset with serious difficulties and possible risks. But Hedin's pioneer journey of 1896 showed that it was practicable under certain conditions, and as there were ruins to be visited near the Keriya river course I decided to try the "short cut" and thus to save time.

I could not disguise to myself the difficulties to be faced with a relatively large caravan when I ascertained at Shahyar that the report

FIG. 16.—CROSSING HIGH DUNES IN TAKLAMAKAN TOWARDS KERIYA RIVER END.

FIG. 17.—HALT IN DEAD DELTA NORTH OF KERIYA RIVER.

about available guides was quite wrong, and that no hunter from that side had ever been known to reach the Keriya river. While Hedin coming from the south had left the end of the Keriya river with the certainty of striking the broad goal of the Tarim right across his route at some point or other, our hope of reaching water within reasonable time depended solely on our steering correctly across some 150 miles of high dunes, towards a particular point, and on the assumption that the Keriya river still actually sent its water there. Now, I knew well by experience the difficulty of steering a correct course by the compass alone in a real sea of sand devoid of all directing features. I realized also that however justified my reliance in Hedin's mapping was, differences in calculated longitude were bound to be considerable on such deceptive ground, and in our case all depended on the assumed longitude being right.

On January 29, 1908, we left the last shepherd huts on the Tarim with eight labourers from Shahyar to help in well-digging and eventual excavations, and with food supplies to last one and a half months for our whole party, counting altogether twenty men. The fifteen camels we took along for transport were by no means too many, considering that at least eight were needed for the carriage of ice. Of course, everybody had to walk, though I had this time rather rashly agreed to take four ponies along too, in order to assure greater mobility for my Indian assistants and myself once we should have struck the river.

After a trying tramp of eight days over dunes rising often to 100 feet and more (Fig. 16), we reached the northern edge of the dried-up delta which the Keriya river had formed at some ancient period. It presented itself as a perfect maze of dry river-beds, all half buried under drift-sand and often completely disappearing amidst thick jungle of trees and scrub dead since long ages. Here our real trouble began; it was as if after navigating an open sea we had reached the treacherous marsh coast of a tropical delta without any lighthouses or landmarks to guide us into the right channel. And yet safety depended on our striking this channel, *i.e.* the particular dry bed which still receives subsoil water from the dying river, and thus would allow us to replenish our much reduced ice supply by digging wells.

Fortune seemed at first to favour us; for we managed to secure a modest quantity of water from a well dug just where we first came upon that forbidding dead delta after crossing huge ridges of sand heaped up to fully 300 feet or more. But the first buoyant hopes of easy progress which this raised in us all, soon died away as we tramped further and further south, always eagerly looking out for the strange dead river-bed which it seemed our best course to follow, and always losing it again amidst piled-up dunes and that deceptive expanse of dead forest (Fig. 17). Nowhere on my desert travels have I met ground so confusing and dismal. Attempts to dig wells failed again and again,

even at places where wind erosion had scooped out the dry bed to a depth of 25 feet and more below the original banks, and where these were marked by a few wild poplars of great age still living. The hearts of the men, except my brave Surveyor Lal Singh, and a few of my old followers like Ibrahim Beg, Jasvant Singh, and that plucky camelman Hassan Akhun, were sinking lower and lower. When five more weary marches had passed without bringing us to water the increasing alarm of the Shahyar men became a cause of serious concern. Thought of flight was ever tempting them to what was bound to prove destruction.

On the sixth day after we entered the delta, I was just arranging for Lal Singh and myself to push out on reconnaissances in opposite directions to west and east, when at last the view from a huge sand ridge of some 300 feet height, which I had opportunely persisted in climbing to the very top, revealed in that vast expanse of grey and yellow bleakness a few strange streaks of white. It was the glittering ice-sheet of the river, and the relief was intense when after a long tramp eastwards we arrived at it—and were sure that it was not merely some salt-encrusted marsh bed. It was time for us all to reach the river. The camels had tasted no water since fully a fortnight, and the poor ponies none for five days except a few glassfuls, all I could safely spare from the precious remnant of our ice supply. We humans had been rationed for the same time to the scanty allowance of about one pint per diem and man. The ever errant river had formed a new bed, some four years before, as I found out subsequently, at a considerable distance to the west of the one where Hedin had seen it, and the sands through which it now flowed were still absolutely sterile. It took several days more before we arrived at living forest and found the new river-bed branching off from the former one not far from Tonguz-baste, the northernmost shepherd's station I had reached in 1901.

The ground we had passed through had its own fascination, and survey work on it offered considerable geographical interest. Yet I was glad when after a day's rest I could resume archæological labour at the Kara-dong site, which the river by its latest change has approached again after long centuries. On my first visit in 1901 a succession of sandstorms had prevented a complete examination of the site, and the shifting of dunes had since laid bare ruined dwellings then too deeply buried beneath the sand. Their excavation now furnished definite antiquarian evidence that a small agricultural settlement, and not merely a frontier guard post, had existed here far away in the desert during the first centuries of our era. Having been joined on the Keriya river by a party of my old "treasure-seeking guides" from Khotan, I marched with them by a new route to the desert belt north of the oasis of Domoko. There in the deceptive zone of tamarisk-covered sand-cones they had succeeded in tracking an extensive but much scattered series of ruined dwellings, with several

Buddhist shrines which had previously escaped our search. Though these ruins had suffered much through the vicinity of 'Old Domoko,' a village site occupied until some sixty years ago, my excavations were rewarded in the end by valuable finds of well-preserved manuscripts in Indian script, Buddhist frescoes and paintings on wood, etc. The time of abandonment was here, too, about the end of the eighth century A.D.

March and April were thus spent in supplementary archæological labours along the desert fringing the oases from Domoko westwards to Khotan. Amongst the ruins newly traced it must suffice to mention the remains of a large Buddhist temple decorated with elaborate frescoes, which, completely buried under high dunes, came to light now in the desert strip between the Yurung-kash and Kara-kash rivers. Like the great Rawak Stupa, discovered in 1901, on the opposite bank of the Yurung-kash in a closely corresponding position, this temple belonged to the early centuries of our era. Unfortunately here, too, subsoil moisture had, as at Rawak, played havoc to such an extent that continued excavation would have resulted in complete destruction. We then set out northward for Aksu by the desert route which leads along the Khotan river-bed, then practically dry. While following it I had the satisfaction of discovering the ruins of a fort once guarding the route, on the curious desert hill of Mazar-tagh, which, as the last offshoot of a low and now almost completely eroded range from the north-west, juts out to the left bank of the Khotan river. The fort had been destroyed by fire, but on the steep rock slope below huge masses of refuse, thrown down by the occupants in the course of long years, had fortunately remained in excellent preservation, safe alike from moisture and driving sand. In the course of three days' hard work we recovered from them a great collection of documents on wood and paper, in a variety of scripts, and none apparently later than the eighth and ninth centuries A.D. Tibetan records predominated pointing, as in the case of the ruined fort of Miran, to the period of Tibetan invasions.

We reached Aksu early in May, after suffering a good deal *en route* from the heat of the desert and a succession of standstorms. There I arranged, through the kind help of my old Mandarin friend, Pan-Ta-jên, now Tao-tai, for the local assistance which Rai Lal Singh needed for the continuous survey he was to carry through the outer Tien-shan range as far as the passes north of Kashgar. I myself, after foregathering for a few days with that most learned of Mandarins and kindest of friends in China, travelled up the Uch-Turfan valley, where opportunities offered for useful anthropometrical work, and then made my way across a barren and yet remarkably picturesque range, previously unsurveyed, to the little-known oasis of Kelpin. The fantastically serrated peaks, often curiously recalling the Dolomites, reach up to 12,000–13,000 feet; but they carry very little snow, and throughout these mountains want of water is a serious trouble for the few Kirghiz

herdsmen who still cling to them. Apart from useful observations about obvious desiccation which I could gather here and in the equally barren outer ranges, it was of special interest to me to study conditions such as may be supposed to have prevailed in the now absolutely waterless hills of the Pei-shan south of Hami during the period when Hun raiders could still make their way through them towards Tun-huang and the great Chinese route to the west. In fact, Kirghiz raids of a similar kind upon the Aksu-Kashgar high-road are still a matter of living recollection, and might yet be revived in practice if the hold of the Chinese administration were relaxed.

Information opportunely secured through treasure-seekers of Kelpin subsequently enabled me to trace extensive *débris* areas marking ancient settlements in the desert between the arid outer hills of Kelpin and the lower course of the Kashgar river. Though far-advanced erosion had left little or no remains for excavation, I secured ample archæological evidence showing that this tract had been occupied down to the eighth century A.D. by large settlements, to which canals, still traceable in parts, carried water from the Kashgar river. I also ascertained the line of the ancient Chinese high-road to Kashgar which had passed through them. There was room here also for interesting topographical work, as I discovered in this previously unsurveyed desert belt a series of low parallel ranges clearly connected geologically with the curious rugged hills about Tumshuk and Maralbashi, which have hitherto figured in our maps as isolated rock islands.

The increasing heat and the thought of the many heavy tasks still before me obliged me to return now to Khotan, which I reached after a fortnight's rapid travelling, made specially delectable by a steady succession of sandstorms. Then followed, in the shelter of my favourite old garden palace at Khotan, six weeks of constant toil, absorbed entirely by the sorting and packing of my archæological collections—a task which, in view of the long journey before them and their often very fragile contents, required my utmost care. Never, perhaps, has the ancient oasis seen such making of cases, tinning, etc., as went on in the courtyards of my old palace during those long hot weeks. In the middle of all this toil I had the great grief of seeing Naik Ram Singh, my "handy-man," who had left me at the close of March for a supplementary task at Miran, return from his long journey eastwards suffering from complete loss of eyesight. He had left me in what seemed good health, and nothing then suggested the approach of the fell disease, glaucoma, which struck him with blindness first on one eye, and then on the other, while he clung with truly heroic doggedness to his task at that distant desert site. What anxieties and efforts it cost me to have the poor sufferer first taken to Yarkand, where the Rev. Mr. Raquette of the Swedish Medical Mission diagnosed the incurable disease, and thence conveyed, with all possible care for his comfort and safety, to India,

may well be imagined. On my return to India I did my utmost to urge the claims of this faithful companion to special consideration, and some months after I had the relief to know that the Government of India had generously provided for his and his family's needs by the grant of a special pension on an adequate scale.

Before the end of July my energetic surveyor, Lal Singh, rejoined me. After carrying his plane-table survey along the Tien-shan to Kashgar, he had succeeded in mapping the last portion of *terra incognita* on the northern slopes of the Kun-lun west of Khotan. On August 1 I was able at last to despatch my heavy convoy of antiques, photographic plates, etc., making up fifty camel-loads, safely to the foot of the Kara-koram passes, where it was to await me, and to start myself with Lal Singh on my long-planned expedition to the sources of the Yurung-kash river. It meant farewell to my old Khotan friends, and, alas! also to my devoted secretary and helpmate, Chiang-ssŭ-yieh. It was a sad parting, though I had the comfort of having, through my friend Mr. Macartney's kindness, obtained for him the amply deserved appointment as Chinese Munshi at the British Consulate in Kashgar. The Government of India have since marked their appreciation of his excellent services by the award of a valuable gold watch.

My previous explorations in the Karanghu-tagh region had convinced me that the Yurung-kash headwaters were quite inaccessible through the narrow and deep gorges in which the river has cut its way westwards. So a fresh effort was now to be made from the east, where that wholly unexplored mountain region adjoins the extreme north-west of the high Tibetan tableland. Climate and ground were sure to offer great obstacles in that inhospitable region. So I had been obliged to bestow much care and trouble on preparations about transport and supplies for this concluding expedition. But for these our undertaking could never have proved the complete success which it did in the end.

The difficulties began early when we made our way through the terribly confined gorges above Polur to the northernmost high plateau (circ. 15,000 feet above the sea) adjoining the outer main Kun-lun range. There we had the good fortune to fall in with a small party of yak-hunters from Keriya, one of whom, Pasa, a wily but experienced fellow, could after much trouble be prevailed upon to show us a track to the uppermost Yurung-kash gorge. Leaving behind a depôt of all supplies for men and beasts not immediately needed, we reached, under his guidance, first the deep-cut valley of Zailik, of which all knowledge had previously been denied by the reticent hillmen of Polur. There we found extensive gold-pits dug into the precipitous cliffs of conglomerate just above the gneiss of the stream-bed, and evidently worked since long ages. In the old days, when the digging was carried on by forced labour, this terribly rugged gorge, with its inclement climate, must have seen more human misery than one cared to think of.

Everywhere we noticed old pits with their mouths roughly walled up, the only available places where to bury the victims.

Forbidding as this valley of Zailik is, its discovery proved to us of great value. In spite of the very steep ridges confining it, we managed to ascend from it a series of high spurs coming straight down from the main Kun-lun range northward, and by establishing survey stations close under its crest-line (here showing an average height of 20,000 feet) to map with theodolite, plane-table, and photographic panoramas, the greater portion of the inexpressibly grand and wild mountain system containing the headwaters of the Yurung-kash. On the south, for a distance of over 60 miles, we could see them flanked by a magnificent range of snowy peaks, rising to over 23,000 feet, and all clad with glaciers more extensive than any I had so far seen in the Kun-lun. Now at last I could form a true idea of the unfailing stores of ice which supply the Khotan river with its enormous summer flood, and enable it then for a few months to carry its waters victoriously right through the thirsty desert.

The Zailik mines, accessible only during a few summer months, are now almost deserted. Yet we managed among the small groups of miners, practically all bond-slaves, still toiling in this gloomy gorge, to secure those eight to nine carriers without which it would have been quite impossible to transport our indispensable baggage and instruments over the very difficult ground before us. By crossing a succession of side spurs over passes 17,000 to 18,000 feet high and subsequently ascending the extremely confined gorge of the main river, we penetrated after eight trying marches to the great glacier-bound basin, circ. 16,000 feet above the sea, where the easternmost and largest branch of the river takes its rise (Fig. 18). The track we followed was that of wild yaks, and in places impracticable even for our hardy donkeys, unless unladen. The crossing of the glacier-fed side streams proved often dangerous, though the summer had now nearly passed from this elevated region. Compensation for all these difficulties offered in the excellent survey stations to which we could climb *en route* at heights from 18,000 to 19,000 feet. The formation of these rugged mountains and valleys presented abundant geographical and geological interest, and with a view to the latter, I did my best to secure geological specimens and records throughout this expedition.

After thus tracing the great river to its ice-bound head, we turned east to high but far easier ground near the Ulugh-kol lake, where our depôt of spare transport and supplies awaited us. There remained now the task of following the great snowy range which flanks the Yurung-kash headwaters on the south-east and south, along its southern slopes westwards until we reached the uppermost valley of the Kara-kash river. For this purpose we had first to march by the Polur-Lanak-la route to the elevated basin (circ. 17,000 feet above sea) where the

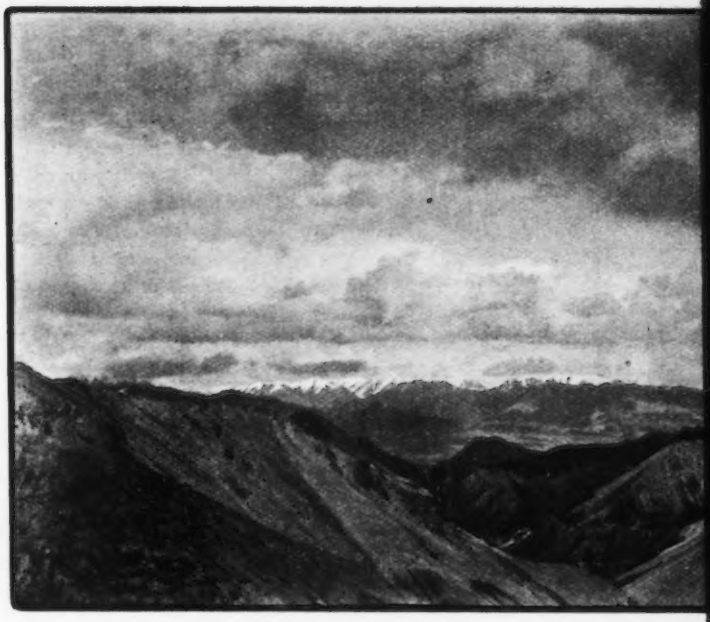

FIG. 15.—VIEW SOUTH, TOWARDS PEI-TA-HO

FIG. 18.—GLACIERS ENCIRCLING BASIN OF EASTERNMOST

DS PEI-TA-HO VALLEY AND ALEXANDER III. RANGE, FROM PASS ON TOLAI-SHA

EASTERNMOST YURUNG-KASH SOURCES, SEEN FROM SURVEY STATION, CIRC.

I-SHAN RANGE.

IRC. 19,000 FEET ABOVE SEA.

Keriya river rises at the foot of a line of great glaciers. The range from which these descend proved identical with the easternmost part of the ice-clad range confining the Yurung-kash sources. Our passage up to the Keriya river headwaters, and for days after, was greatly impeded by very trying weather. Frequent snowstorms swept across the high plateaus and valleys, and the slush they deposited, slight as it was each time, soon converted the gentle slopes of detritus into veritable bogs, very difficult to cross for animals already suffering from the effects of great altitude, exposure, and an almost total absence of grazing.

I was heartily glad when at last we left behind the watershed of the Keriya river, and could commence our exploration of the ground westwards which in our atlases generally figures as a high plain with the name of Aksai-chin, but which the latest transfrontier map of the survey of India rightly showed as a blank. Instead of a plain we found there high snow-covered spurs with broad valleys between them descending from the great range which flanks the Yurung-kash sources. A series of large lakes and marshes mainly dry extends along the foot of those spurs, at an elevation of 15,000 to 16,000 feet; but the streams brought down by the valleys rarely reach them, losing themselves instead on vast alluvial fans of detritus. Depressions connecting those lakes, and running from east to west, greatly facilitated our progress. But their increasing barrenness told heavily on our ponies and donkeys, of which, in spite of all care, nearly one-third succumbed in the end. Vegetation, such as it is on these Tibetan uplands, disappeared almost completely after one march from the first lake, and soon fresh water, too, ceased to be obtainable except by digging in dry watercourses. Icy gales pursued us for most of the time, and made the bitterly cold nights doubly trying both for the men, who had difficulty in collecting enough fuel, and for our poor animals, which had neither shelter nor grazing.

But the most dismal ground was still before us when, after a week of long marches from where we had left the Polur-Lanak-la route, we reached a large salt lake which an Indian Survey party appears to have sighted more than forty years ago, but which has now been reduced to the state of a salt-marsh for the most part dry. Marching round it to the north-west, we entered a series of basins absolutely sterile, and showing in their centre a succession of salt-encrusted dry lagoons. Death-like torpor lay over the whole region; no living creature could be sighted nor even the track of one. There, to my grief, I lost my hardy Badakhshi pony, which had carried me ever since I entered Turkestan, except when I worked in the desert, and had never shown signs of distress, even when crossing the Taklamakan on the scantiest allowance of water. It was a great relief when, after three depressing marches, we struck traces of the old route, forgotten since more than forty years, by which Haji Habibullah, chief of Khotan at the

commencement of the last Muhammadan rebellion, tried to open up direct communication with Ladak and India, and over which Mr. Johnson, in 1865, had been taken on his adventurous visit to that ill-fated ruler. The survival almost intact of the cairns, the stacks of Burtse roots to be used as fuel, and of other relics left behind by those who followed this route during the few years it was open, was a characteristic proof of the dryness of the climate even on this high elevation. We had used up the last of our fodder store when, guided by those marks and crossing several side spurs from the main range, we emerged at last, on the evening of September 18, in the valley of an eastern feeder of the Kara-kash. Descending this, I was joined two days later by a party of Kirghiz with yaks from Shahidulla, whom I had ordered from Khotan to await my arrival here.

The only task now remaining was to trace Haji Habibullah's route up to the point where it crossed the main Kun-lun range towards Karanghu-tagh. A line of cairns running up a side valley showed where the pass would have to be looked for. But advancing masses of ice and snow had obliterated all trace of the old route at the head of the valley. As, however, it was important to fix our position accurately by linking it up with our former surveys from the north side of the main range, I ascended on September 22, with Lal Singh and some Kirghiz, a steep glacier which seemed to offer the nearest approach to the watershed. The ascent, over miles of much-crevassed ice and *névé*, deeply covered with fresh snow, taxed us severely, and it was late when at last we had gained the crest at an elevation of about 20,000 feet. The fine view before us northward showed that we stood at the head of one of the great glaciers descending from the main range towards the Nissa valley explored in 1906. Mapping and photographic work delayed our descent in spite of a temperature of 16° below freezing-point at 4 p.m. with the sun shining. No halt was possible *en route* from fear of getting altogether benighted, and when late in the evening camp was reached, I found that the toes of my feet had been severely injured by frost-bite. This was bad luck, indeed, but I was glad all the same to know that our exploratory tasks had been carried through to their end.

Realizing the serious results of this accident and the urgency of surgical help, I had myself carried down the Kara-kash valley as well as I could. There, at Portash, I had the satisfaction of seeing my heavy caravan of antiques safely arrived across the Sanju pass. I left this valuable convoy in charge of Rai Lal Singh, who had all through displayed zeal, energy and utter indifference to hardships such as I had never seen equalled by any Indian. I am glad his merits have since received due recognition by the award of the title of Rai Bahadur on the part of the Indian Government. I myself moved ahead towards Leh as rapidly as the conditions of the difficult

Karakoram route, leading over passes of more than 18,000 feet and the troublesome Sasser glacier, would permit. Without the timely help sent up by Captain D. G. Oliver, the British Joint Commissioner in Ladak, I could never have got myself carried across in my improvised litter. After nine long marches I arrived at the first Ladak village, where the Rev. S. Schmitt, in charge of the hospital of the Moravian Mission at Leh, kindly met me. Four days later I reached Leh, where he could perform the operation necessary on my right foot, all the toes of which had to be amputated, and where his kindness and that of his fellow-missionaries provided me with much-needed comforts. But nearly three weeks passed before I was considered strong enough to face the fatigues of the fortnight's continuous travel down to Kashmir, where another long halt was imposed by the medical advice of my old mountaineering friend, Dr. Neve; but this was made quite pleasant and refreshing by the kind hospitality and attention I enjoyed on the part of the Assistant Residents, Captains Oliver and Macpherson. At last, at the commencement of December, I could begin my first attempt at walking, and start on my way down to India. Urgent work of all sorts and a visit to Calcutta, where his Excellency the Viceroy, Lord Minto, gave fresh proof of the kind personal interest with which he had followed my travels throughout, and of his kind thought for my Indian assistants, detained me until the close of the year. Thus it was not until the close of January last that I could reach England, where all my cases with antiques, close on a hundred in number, had just then safely arrived.

The return from a long journey like mine cannot mean rest, but only a prelude to labours in some respects more arduous and important than the work in the field.

The results achieved by my expedition would for the greatest and most valuable part be thrown away, if all the exact observations bearing on the physical conditions, past and present, of the wide regions traversed; on the ruins unearthed and surveyed; on the antiquities and manuscript remains which have been brought to light by the thousands—were not to be carefully recorded by myself, and made thus available for further researches. To give some idea of the extent of these tasks, I may mention that our topographical surveys, which are at present being prepared for publication by the Trigonometrical Survey Office, will, on the scale of 4 miles to 1 inch, fill close on 100 map sheets of the standard size, every one needing careful revision in proofs; and that the mere unpacking and first arrangement of the thousands of archæological objects, a task on which I am now engaged, will, with such assistance as is available, probably not be completed before August. The decipherment of the manuscripts and individual documents, probably close on 8000 in number, and in about twelve different scripts and languages, will claim the attention of quite a

staff of Oriental experts, and their labours cannot be started in full earnest until all facts bearing on the origin, date, etc., of the finds, as observed by me on the spot, have been thoroughly sifted and published. So, with all these tasks and responsibilites before me, I can at present cherish no more eager wish than that my efforts to secure adequate leisure may be successful, and that I may thus be able to do to the end what I feel is my duty to science.

The PRESIDENT (before the paper): It is just about six years since Dr. Stein last visited us in order to describe his first journey in Chinese Turkestan, a journey which proved him to be an explorer of the very first rank. With such a record as his, very few words are needed to introduce him to this meeting. Dr. Stein, a Hungarian by birth, was very early in his career attracted to this country, on account of the facilities for linguistic study. He came here and worked for three years on Eastern languages. At the end of that time he went to India and joined the Punjab University, where he worked, if I remember rightly, for about eleven years. Then he was appointed to the Imperial Educational Service, and became a naturalized Englishman. After one year in that department, he was sent on his first journey, the one I have already alluded to. But before he went on that journey he had employed his leisure time in India in working hard at historical, geographical and archæological problems, and he produced a great deal of work, which was in itself of great value. He was, in fact, preparing himself in the best possible way for the work in connection with these two great explorations. It is not my intention to take up your time, but I did wish to say these few words, so that every one should know that in listening to Dr. Stein we are listening to one who speaks with greater authority on the historical, geographical, and archæological problems of the regions he visited than any other living man.

After the paper the following discussion took place:—

Mr. MACARTNEY: As one who has had the good fortune to spend many years in Chinese Turkestan, I am specially pleased to hear the allusions made by Dr. Stein to the courtesy shown him by the Chinese officials in that country, many of whom are my personal friends. If Dr. Stein's travels have been rewarded with such marvellous success, I venture to think that some thanks are due to the local Chinese authorities for the ever-ready assistance they rendered him both in his survey work in the mountains and in his excavations in the desert. Perhaps the following instance of Chinese courtesy may be of interest. In the absence of banking facilities in Eastern Turkestan, one of the difficulties which beset travellers in those regions is naturally connected with the carriage of funds. As we all know, the money of the country is Chinese silver, and silver in large quantities is extremely heavy, besides being a temptation to robbers. Now, although Dr. Stein had made, in a manner, Kashgar his starting-place, yet his travels extended at least to some 1500 miles east of that centre; and his journey lasted for pretty well two years. The question of funds was therefore a most important and difficult one for him. Both the Taotai of Kashgar and the Taotai of Aksu came to his assistance by the issue of orders to their subordinates, not only to help him generally, but also to allow him to draw funds at the local yamêns, against repayment by myself at Kashgar; and accordingly Dr. Stein was able to obtain money at Khotan, Keria, Karashahr, and at some other places. No doubt a financial operation of this kind could have been carried out very easily in a highly developed country; but I know, as a matter of fact, that in this particular instance, which entailed the adjustment of

accounts between treasuries normally having no inter-relation, considerable inconvenience was caused to the authorities. There is another instance of Chinese courtesy, in a small matter, it is true, which I should like to mention. Dr. Stein has given us an account of his journey through the desert from Shahyar to the Keria river. Perhaps he does not know that in the course of this journey, his caravan dropped a camp chair of his. Well, the Chinese amban at Shahyar not only recovered it, but also sent it through the post to me at Kashgar, for transmission to Dr. Stein.

Dr. STEIN: It is at Oxford at present.

Mr. MACARTNEY: On the other hand, if Dr. Stein has been so successful in obtaining the assistance of the Chinese, the reason for it is largely attributable to the consummate tact and *savoir-faire* which he displayed in his dealings with those whose assistance he claimed. When he left Kashgar at the end of his first expedition in 1901, he left behind him, perhaps unknown to himself, amongst the Chinese, a great reputation as a scholar—as one profoundly versed in Chinese Buddhism, and having a special interest in tracing the itinerary of one of its early propagators—Hsuan-tsang, whom he so often mentions in his lecture as his "patron saint." Now, if there is a character that appeals to the Chinese more than another, it is that of a quiet, unostentatious and cultured scholar. In that character, the Chinese at once recognized Dr. Stein, and they honoured him accordingly.

Dr. L. D. BARNETT: I feel it a great honour to be allowed to say a few words to-night as a personal tribute of appreciation to Dr. Stein. Like Odysseus, Dr. Stein has travelled wisely and well, and has seen the cities of many men, and learned their thoughts, and like Odysseus, he has also gone below the face of the Earth and questioned the mighty dead. Now I venture to think that this last achievement of Dr. Stein is one which appeals most strongly to the imagination. As a geographical explorer, he has contributed to science as much as any man in the present generation; as a Sanskritist and Oriental antiquarian, he is surpassed by none of the erudite gentlemen who are the pride of our Western academies. In all these and in several other departments he has contributed enough work for the lifetime of any ordinary man. But the most extraordinary and fascinating achievement of our many-sided Odysseus has been the combination of antiquarian learning and practical insight, a combination constituting genius, by which he has been enabled to bring to light a vast realm of buried and forgotten history. No exploit of equal magnitude, I think, has been made since Sir Henry Layard laid bare the ruins of Nineveh. I well remember the meeting of this Society on June 16, 1902, when Dr. Stein told us how it was that the call first came to him to visit Khotan. There were a few fragments of Buddhist manuscripts, a few mysterious block-prints and scrawls, which his own subsequent experience proved to be forgeries, and these were all the "archæological proceeds" that indicated Turkestan as a likely field for his explorations. Such a bait would have allured no ordinary man, but Dr. Stein, not being an ordinary man, went there, and returned with twelve cases full of treasure. Now he has been here again, and has come back with nearly a hundred boxes. Thanks to Dr. Stein in the first instance, and to the learned explorers who have followed in his track, we are now able to form some idea of the rich culture and eventful history of Turkestan in the first ten centuries of our era. Here was a wealthy kingdom with an Indian administration, carried on in an Indian language, a kingdom with an established Church which brought into its service the exquisite Hellenistic art to which ancient India owed the noblest of its monuments. Here, too, we see this Indo-Greek art gradually becoming modified, until we can almost trace the steps by which it was assimilated on the one hand into the classical art of China, and on the other hand passed away

into the exquisite inspiration of ancient Persia. Equally striking are the documents of another kind. In Turkestan have been found abundant remains, both in literature and art, of the great Manichæan Church, which by the fascinating power of its theology and the strength of its communal organization was able for centuries to wage a deadly war with Christianity. Very important, also, are the remains of Sanskrit works now lost, and likewise all the great masses of Tibetan and Chinese documents which reflect the political relations between the two powers. On all these subjects a surprising light has been shed by Dr. Stein, and great as is our gratitude for this light, it is to a large extent a lively expectation for more to come. Now we see Turkestan no longer as a blank in the vista of history, but as a great centre of military and religious force, which have thence radiated in every direction. Here passed the Mongol and the Turk, the Hindu and the Greek, the Chinaman and the Persian, the Buddhist and Manichæan, each playing their part in the great drama of world-history; and in the rich stores of documents of this culture which the desert has preserved we may hope to find answers to many of the deepest problems, which have hitherto faced the historical student. And as we proceed along this path of knowledge, we shall know with increasing clearness our debt to this scholar who first opened up that road.

After some remarks from Sir H. Howorth,

The President: I think the time has arrived to bring this meeting to a close. No doubt the lecture we have heard to-night does not represent one-hundredth part of the information which will be published when Dr. Stein has been able to work out all his results. It is only an explorer who has taken the immense trouble he has to prepare himself for a journey who can bring back such a mass of information. I should like to mention one little incident. I happened to be sitting between Dr. Stein and Dr. Hedin at a dinner, when Dr. Stein handed me a little tape-measure he had picked up north of Lop-nor. It had been lying there for six years in that desert land uninjured and unmolested, and Dr. Stein asked me to return it to its proper owner, Dr. Hedin, who was sitting on the other side. Dr. Hedin has kindly presented it to our Society, and we thus possess a pleasant memorial of these two great travellers, which illustrates both the extraordinary character of that climate, and also how solitary that desolate land is. The mention of the names of these two great explorers tempts me to make comparison, but I am glad to say that I am also reminded that comparisons are odious. Without incurring that epithet, I may remind you, perhaps, that Dr. Sven Hedin in this room spoke of his own explorations as being pioneer work, a description we can only accept that if by pioneer work is meant that his dominant ambition was to enter lands which had never before been traversed. With regard to Dr. Stein, the dominant idea was somewhat different. According to the terms with the Indian Government, he had to look mainly to archæological work and detailed topographical work, and this necessitated taking with him a considerable number of assistants wherever he went, making the passage of desert places very difficult. He did in certain instances travel with small numbers, but most of his expeditions necessitated considerable caravans. I think that his idea always has been that he should do the work he had to do as well as it was possible to do it at the time, and, if practicable, to leave nothing undone. That should be the ideal in the future for every explorer, because we must recognize the fact that pioneer work is becoming less and less necessary, and there are fewer and fewer blank places on which maps remain to be filled. The explorer who wishes to make a name for himself in the future cannot do better than study Dr. Stein's methods. No man should think it is waste of time to spend years and years preparing himself for his work, and all explorers should take with them trained surveyors, as Dr. Stein did to help in the work. I should like him, from us,

to send a message to those Indian surveyors, to tell them how greatly we appreciate their work. I should also like to place on record how wise and how wide-minded we think it is of the Indian Government to have subsidized an expedition of this sort, and also heartily to congratulate the British Museum for the great assistance that they are giving and have given to the exploration. Naturally, Dr. Stein himself is the central figure in this drama, and it is to him that we wish to give our heartiest congratulations and our warmest thanks. There may be some other opportunity of placing more definitely on record our appreciation of the work done, but I am sure I may to-night, in the name of every one here present, express our thanks to him for giving us one of the most interesting lectures we have ever listened to in this hall.

Dr. Stein: I have been trespassing too largely upon your patience. At present I shall only ask for a minute to express my heartfelt thanks for the friendly interest with which you have listened to me, and the exceedingly kind remarks which Mr. Macartney, Dr. Barnett, and Sir Henry Howorth have made in regard to the results of my work. Naturally, after the appreciation which you have expressed, my hope of being able to finish my work properly has been raised, and for this, as well as for all the encouragement which I have received, I wish to be allowed to express here my deep sense of gratitude.

The following communications were received:—

Lord Curzon of Kedleston: "I wish indeed that I could be present at the reading of Dr. Stein's paper this evening. Conditions of health alone prevent me from having that enjoyment. My interest in his explorations and discoveries is very great and natural, for I had the good fortune, when in India, to sanction his first journey, and to make the preliminary arrangements for the second, the brilliant record of which you will hear to-night.

"His paper will have shown you how speedily the archæologist and the scholar —for as such I shall perhaps not offend Dr. Stein by describing him—can acquire the aptitudes of the geographer and the skill of the descriptive writer; and his works will long remain models of the best type of scientific narrative.

"His remarkable journey suggests several reflections, to which I will briefly allude.

"His discovery of a new and advanced section of the great system of frontier defences with which the Chinese Empire guarded its Western marches against the nomadic hordes of the desert, as long ago as the beginning of the Christian era, is one of extraordinary interest. History preserves faint records of many of these ramparts erected by successive conquerors of different races in various parts of Central Asia; but nowhere did they attain the elevation, the solidity, or the military perfection of the walls erected by the Chinese. They are only comparable in height, though they were greatly superior in length, to the *limites* of the earlier Roman Empire.

"Secondly, the history of archæological discovery contains hardly anything more dramatic or more fruitful than the record of Dr. Stein's long chaffering with the Taoist priest in the caves of Tun-huang, the proceeds of which, I understand, are now in London, and will furnish yet another illustration of those curious meeting-points of the East and West with which Central Asia abounds.

"I should like, indeed, to call attention to the unique advantage of that mysterious region as a scene for the cultured explorer of modern times. No climate in the world is so favourable for the preservation of the relics of the past—where no rain falls, where no irrigation exists, where lakes form only to dry up and disappear, where the footfall of a man has ceased to resound for centuries, where

his last footprints, years and years ago, can still be traced in the sand, where no destructive agency but the wind exists, and where the wind preserves almost as much by its dryness as it destroys by its erosion. Can we conceive a locality better adapted by nature for antiquarian purposes?

"The unbroken silence and the untrodden desolation of these regions have another effect. Centuries shrivel up like a scroll, and travellers who are separated by hundreds of years—Hsuan-tsang, Marco Polo, the Russian explorers, Dr. Hedin, and Dr. Stein—seem to be marching in close file, one behind the other, instead of being sometimes separated by centuries. Indeed, in some places a greater physical change is caused by local conditions in a few years than is elsewhere produced by thousands. Note, too, from Dr. Stein's observations, how in some parts the tide is at length beginning to roll back, and cultivation for the first time for centuries is beginning to gain at the expense of the desert.

"Further, this vast expanse, which the courage and genius of our modern explorers is gradually filling on the map, is the meeting-ground not only of individual pioneers, but of ages and races. The Greeks, the Indo-Scythians, the Indians, the Huns, the Tibetans, the Chinese, all converge at this historical rendezvous, and the sand overlays the records of their marches and meetings with its kindly and protective mantle.

"Dr. Stein could not have accomplished this great journey without many advantages. The experience of his previous journey was invaluable to him; friendly governments sped him on his way; he was fortunate in his native servants, and in that admirable body of Indian surveyors, whose endurance and fortitude no monument could adequately commemorate. But he would have achieved little of what he did had it not been for his own indefatigable ardour, his high courage, his trained abilities, and his indomitable spirit. We read with unfeigned sorrow of his hardships and his sufferings. But even though he left some of his toes behind him, he has brought back a reputation greatly enhanced, and, in the cases which he is now unpacking in London, a treasure-store for our museums, which will, I am sure, compensate him for all that he has gone through, and convince even his inveterate modesty that he has added materially to the knowledge of mankind."

Colonel Sir Henry Trotter: "I regret extremely that I am prevented by illness from assisting at the delivery of Dr. Stein's lecture. I have had the advantage of reading it, and coming as it does so soon after Dr. Sven Hedin's most enthralling description of his three years' explorations in Trans-Himalaya, I think our Society is to be congratulated at having, within the short space of a few weeks, heard the accounts of their journeys by two of the foremost explorers of our time. I had the privilege, at the meeting at the Queen's Hall, of seconding the vote of thanks to Dr. Sven Hedin—a labour of love, I fear very inadequately performed—and nothing would have given me more pleasure than to have had a similar task assigned to me this evening in the case of Dr. Stein.

"Both explorers have shown the same admirable qualifications, both of body and mind, which have paved their way to success—a most invincible and untiring energy and determination to go on, looking at apparently insuperable difficulties ahead only as obstacles to be surmounted; they both possessed bodies seemingly impervious to cold, heat, and fatigue, and minds stored with all sorts of knowledge enabling them to reap a rich harvest wherever they went; and, above all, both appear to possess that magnetic sympathetic feeling which seems to have attracted all with whom they came in contact, leading them to great diplomatic triumphs.

"In the case of Dr. Stein, this magnetic influence seems to have fallen on two successive Governors-General of India, the British Museum trustees (by no means an easily influenced body), the R.G.S. and its officials, the Indian Survey Department

—all of whom helped Dr. Stein in his start; and when once off, he seems to have obtained the most devoted and faithful service from his native assistants, the two Ram Singhs, his Chinese secretary, his camel-man, muleteers, and servants; and even his own patron saint, Hsuan-tsang, came mysteriously to his aid in his very difficult negotiations with the Taoshi of the Hall of the Thousand Buddhas, which ended in the acquisition of archæological and historical treasures of untold value.

"I think that Dr. Stein's hearers this evening will feel that magnetic spell, and if time permits him to describe to you how towards the close of his work his faithful assistant, Naik Ram Singh, lost the sight of both eyes, and Dr. Stein himself, after ascending to a height of 20,000 feet under circumstances of the greatest difficulty, fell a victim to his own zeal, losing all the toes of one foot from frost-bite, the audience will feel as I have felt—a deep personal sense of loss, only partially compensated for by the invaluable results brought back in the shape of geographical, archæological, and other scientific results which will probably take many years before they are thoroughly worked out."

Colonel Sir T. H. Holdich: "I should be grateful to you if you would express to Dr. Stein the great disappointment which I feel at not being able to attend his lecture. Please offer him my warmest congratulations on the marvellous results of his two years' research. Looking back over the last few years' record of papers read before the Society, papers dealing with farthest north and farthest south, with Equatorial Africa and with highest Asia, I can recall nothing to rival the paper read to-night in the depth of its human interest. I feel certain that the geographical results of so wide a field of exploration will ever rank with the very best records of Indian geographical surveys, and it is with the greatest pleasure that I read Dr. Stein's generous recognition of the services of his native staff. But it is easy to see that the spirit which animated them was his own. He has the faculty of imparting his own indomitable energy and enthusiasm into those who follow his lead. His Asiatic colleagues, Indian and Chinese, did their duty nobly and bravely, but I venture to think that whenever the call to face difficulties and hardships in the cause of scientific research comes from a determined, yet wholly sympathetic, leader like Stein, there will never be lack of response."

Dr. Sven Hedin: "I have read Dr. Stein's paper with the greatest interest, and although it was impossible for me to be present at the lecture itself, I cannot help writing a few words expressing my sincere and deep admiration for the splendid work Dr. Stein has carried out on his second expedition in Central Asia, as well as on his first. The magnificent treasure of old records and documents he has brought home will form a most important addition to his first collection, and he and his collaborators will be able to spread new light over the ancient history of those immense countries where now nothing but deserts and moving sands prevail. We are in a most interesting and unexpected era of Central Asian exploration. The epoch of geographical discoveries is almost gone, although a lot of detailed work is still left to be done. The time of archæological investigation has set in. It began years ago with 'Bower's manuscript,' Petrovsky's, Macartney's, and Deutreuil de Rhins' collections, and with my discovery of Dendan-uilic, and Kara-dung, those sand-buried cities in Takla-makan which later on were visited and examined so carefully by Dr. Stein. The archæological investigation has now taken a great step forwards. From several different countries, England, Germany, France, Russia, America, expeditions have been sent out, but one can hardly talk of any competition—the deserts are big enough for as many parties as Europe, India, and America can afford to send out, and for some more still. From what we already know we have every right to draw the conclusion that there must still rest under the moving sands whole civilizations of different ages and races. The records now brought

home by Stein, Grünwedel, Lecocq, and the rest are so overwhelming as to keep a whole staff of experts busy for years to come, and in Paris I heard from Sénart and Chavanne that they could hardly see any end of the work before them. A quite new science, or anyhow a new branch of ancient history, is in this way steadily growing up from the deserts of Central Asia, and I congratulate my friend Stein most heartily on the splendid and glorious place he has conquered for himself in this fascinating branch of science.

"When in the beginning of 1906 I travelled down the Kerya-darya to its end, and thence through the desert to Shah-yar, I did not regard this journey as any particularly great risk, as the river and its underground continuation showed me the road. It was a much more, incomparably more, dangerous task Dr. Stein faced when he went the same way—in the opposite direction. Everybody will easily understand this from a single glance at the map. Wherever I went, keeping fairly straight north, I could not help reaching the Tarim river sooner or later, whereas Stein, coming from the north, had only one single point to keep on, namely, the point where Kerya-darya dies away in the sand. Everybody who has travelled in the Takla-makan will understand what it would have meant for Stein if he had not reached this very point—he would very likely have lost both his own and his followers' lives in the killing desert, situated to the east and west of the Kerya-darya. As nothing else existed from this part of Asia except my map, I should have had a terrible responsibility for his fate if he had not found the inland or desert delta of the river. So nobody can be more glad than I that this most dangerous journey of Stein's went off in such a happy way. The fact that the delta had changed its place some miles is only a new proof of the instability of the rivers in the desert—a phenomenon that both Stein and I have studied and described on so many different occasions.

"I am very glad, also, to hear from Dr. Stein's paper that he was able to find the old site of Lou-lan from my map. It is by no means easy to find the place. Everything is grey and yellow; the 'yardangs' are very like ruins, and the ruins like yardangs; old dry trees look like parts of houses, and *vice versâ*, and one can be quite near the place without seeing it. I, or rather one of my Russian cossacks, discovered the ruins only by chance, but one year later I visited it again, coming from the north, and of course following my own map. It was more difficult to find the place from the south as Stein did. I am not an archæologist, so I cannot take part in a discussion as to whether this place is Lou-lan or not. I have called it Lou-lan from a communication by Karl Himly in Wiesbaden, who undertook to work out and publish my records, almost all of them Chinese. Dr. Stein says in his paper that these ruins were not Lou-lan, this place being situated further south. After the death of Karl Himly, my collection had a rather long time of rest, until Prof. Conrady of Leipzig continued Himly's work, and is still busy with it. I asked Prof. Conrady the other day about Lou-lan, and he positively says that the site in question *is* Lou-lan and nothing else, and that there are absolutely sure proofs of the fact in the collection of manuscripts I brought home. But, as I said before, the discussion about the real situation of Lou-lan is a matter which I leave, without the slightest jealousy, to the experts.

"It is of very great interest to learn from Dr. Stein that those new lakes I found in the Lop desert had almost disappeared at the time of his visit. Does that mean that the lakes are in a period of shifting, or that in general the volume of water carried down by the Tarim has been diminishing during recent years? Dr. Stein's maps and measurements of the river will tell us about this question, and will give us all the material necessary for comparison and conclusions.

"There are several other things in Dr. Stein's paper which invite interesting

discussion, but I have no time now. This last journey has opened up magnificent prospectives, not only in the field of archæology, but also in the field of physical geography—formation of deserts and dunes, wind-erosion, desiccation, the wanderings of rivers and lakes, etc.—and it is not difficult to understand how closely the physical phenomena of Central Asia are connected with the archæology, the explanation and understanding of the possibilities of ancient culture, the causes of migrations of nations, the extinction of empires, the disappearance of roads and stations, etc. The one cannot be understood without the other. From a verbal communication of Dr. Stein, I am glad to hear that he quite agrees with my theory (vol. 2, 'Scientific Results') of the curious morphology of the Lop desert, and specially about the formation of 'yardangs' by the action of the wind-erosion. A detailed description of any part of the Earth is always extremely valuable, not only for its own sake, but also because it affords the next explorer the possibility of deciding in which direction the changes go, and this holds good specially for deserts like Takla-makan and Lop, where the changes are so very rapid. No doubt Dr. Stein will later on give us many important conclusions to which he has come by comparing his own observations with mine, which he had no time to mention in his lecture. He will be able to tell us the changes in the bed of Kerya-darya, which he visited ten years after me, and he will tell us a good many things about the desperate struggle between the water and the sand in the Lop desert."

THE WESTERN PACIFIC: ITS HISTORY AND PRESENT CONDITION.

By Sir EVERARD F. IM THURN, K.C.M.G., C.B.

Among the most picturesque even of Fijian words is the word *wailangilala*, literally "water-sky-emptiness" but as a whole meaning the horizon. The picture suggested by the word is of the glittering line where, as far away as a man can see, sky and sea seem to meet and blend, and where any object, it may be ship or island, is barely discerned. The word is in many ways peculiarly appropriate to much in the Pacific; and it seems to me still more appropriate to the conceptions formed on this side of the world of the conditions now existing in the great ocean on the other side of the globe. Even many Fellows of the Royal Geographical Society would be hard put to it to say offhand anything of the position, history, allegiance, or general condition of the Fiji, Cook, Society, Sandwich, Tonga, or any other of the innumerable islands of the Pacific, the very names of which are merely dimly recognizable to most of us until and unless our personal interest is evoked as to any of them. I remember telling one of our present legal luminaries that I was to be Governor of Fiji, and I remember his reply congratulating me on at last becoming King of the Cannibal islands, but asking where that kingdom might be. I have since spent some four years as Governor of Fiji and High Commissioner of the Western

* Read at the Royal Geographical Society, May 10, 1909. Map, p. 360.

Pacific—two quite distinct offices—and cruised among a large number of the island groups of the Pacific; I have collected and to some extent used a very large library of pertinent books; and I think I cannot do better, in the brief time at my disposal to-night, than give you a short outline sketch of that ocean, and especially of the British interests within it, as these present themselves to me. Some day, if before I die the fates grant me the necessary leisure, I mean to try to write the book on the Pacific which has never been written as a whole; meanwhile I make no other apology for the shortness and incompleteness of my present sketch.

Any map of the Pacific ocean—as we now know, or can know, it—will serve to remind you of its main land limits; but for my own ashamed personal experience of what every Fellow does not know until he has occasion to find out, I should be shy of reminding such an audience that this vast stretch of still lonely sea is bounded, as the old school geography books said, by the whole of the western coast of America, from Cape Horn to Alaska, and by the eastern coasts of Asia and Australasia and New Zealand; that the only opening northward is by the narrow Behring straits to the northern Arctic regions; and that to the south it lies widely open to the Antarctic regions.

I like to carry my mind back—I want you to go with me for a few minutes—to the time when even these elementary facts were unknown; when the very existence of the ocean which we are considering, and even of Australasia, was unknown; when certain landfalls on the eastern shores of the "New World" which was to be America had barely been made; when Balboa, having tramped across the isthmus which, as afterwards appeared, unites the two great land areas, then largely unknown, which form the "New World," was the first of Europeans to set eyes on the "South Seas," since, by strange misnomer, called the Pacific; when Magellan (in 1519) succeeded in sailing round Cape Horn into what eventually proved to be the same seas, and passed across these, by no will of his own, but by the force of currents, till (in 1521) he reached on its western limits the islands of Asia, and found that the Portuguese had arrived there ten years before him.

The seas across which Magellan passed were then indeed Wailangilala. This is not the place or time in which to describe in detail the wonderful voyages of those after Magellan, who from the east or the west sailed over those still unknown seas, discovering scattered islands which were subsequently again lost sight of.

Three more or less connected voyages—of Spaniards from Peru in search of the great southland which they believed to exist in the south seas—must suffice as samples of the rest. In 1567, Mendana, after sighting the Ellice islands, and probably Ongtong Java—of both of which I shall make further mention presently—found and named the Solomon

islands. In 1585, Mendana, with Quiros, again seeking the isles of Solomon, but drifting slightly too far to the south, came instead to the Islands of the Holy Cross (Santa Cruz group). Subsequently, Mendana having died, Quiros again set sail, in 1606, in search of the Solomon islands, which he believed to be the Southland of his dreams, and came this time to a land still further south than the Santa Cruz of his previous voyage; and this new landfall he believed, and believed to the day of his death, to be part of the much-sought great continent stretching to the southern limit of lands; and he called the great land which he thought he had discovered Austrialia del Espiritu Santo, the first word in compliment to his Imperial Master of Austria. In the "Great Bay

NATIVES OF ONGTONG JAVA.

of St. James" on that island, and on the banks of the river which flows into that bay, which he christened the river Jordan, he founded the town of the "New Jerusalem;" and then he, with such of his party as survived, at once returned by the way they had come, to seek colonists and help, quite in vain, for the new "continent." His "continent" was really a small island of the New Hebrides group, the island still called "Espiritu Santo," part of the name given by Quiros, though the "Austrialia" which was the first part of his name has been transferred—under the changed form of Australia—to the adjoining great island which we now know represents the southland continent of which Quiros and his contemporaries dreamed.

After the death of Quiros no more was heard of the "Solomon islands" for a couple of centuries, though voyages to the Pacific such as he had made by no means ceased.

It will be noted that the adventures to the South seas of which I have as yet spoken have been of Spanish origin, and took place when Spain, in her greatest days, was seeking to extend her "New Kingdom" from Peru to the limits of Portuguese East India. But the successes of Spain in the Pacific, small and sporadic as these really were, attracted, during the seventeenth and part of the eighteenth century, a crowd of envious privateers of many European nations—and these new-comers made many further discoveries of small scattered islands in the Pacific. About this time, too, the Dutch East India Company—for the sake neither of conquest and conversion of natives nor of fighting the Spaniards, but for trade—frequented the Pacific; and these traders also contributed to the many tales set afloat in Europe of discoveries in the South seas. For instance, one of these, the great Tasman, in 1642–3, was the first to see and land in the Tongan islands and to sight what we now know as the Fiji islands; he too saw Ongtong Java, as had Mendana before him.

During the two and a half centuries after Magellan, while all this vague discovery of things in the Pacific was going on, a very notable series of other voyages was made into the Wailangilala of the Pacific; and it is as a result of these voyages that real knowledge of the Pacific first began to take definite form.

This time the motive which, at least nominally, spurred on the adventurous voyagers was the spirit of scientific discovery, in which the English and French of those days vied with each other in true sportsmanlike fashion. Among the splendid names of those who took part in this great game, perhaps the most splendid are those of Captain Cook and his fellow-captains, and of the Frenchmen, De Bougainville, La Perouse, and D'Entrecasteaux. Of Captain Cook it is not necessary for my present purpose to say more than that, between 1768 and 1774, he not only visited most of the groups of the Western Pacific, of which I shall presently have to speak—more especially the "Friendly islands," *i.e.* the Tongan group, the New Hebrides, New Caledonia—but that he made a very considerable part of the actual surveys on which his Majesty's vessels at this day steam through these parts. Bougainville played in the game thoroughly and as if he enjoyed it, and his record of his voyage (1766–9) forms most delightful reading. La Perouse should live in story if only for his remark, when met in the Pacific by the ships of other rival nationalities engaged in the great game of discovery, that "les Européens sont tous compatriotes a cette distance de leur pays;" and he must appear in any history of the Pacific, if only because of the mystery of the fate to which he passed when he sailed out of Botany bay one day in 1788, he, his companions, and his ships never to be known of again, except that some wreckage of his vessels was found some forty years after on Vanikoro, one of the Santa Cruz islands. D'Entrecasteaux's voyage, begun in 1792 in search of La

Perouse, deserves mention; and so, though they did not fall within the century with which I am now dealing, do the voyages of the Englishman Peter Dillon, servant of the East India Company trading to the South seas for sandalwood, which resulted in the discovery of that wreckage in 1826.

It is impossible here not to set in its place another and a very famous incident in the discovery of the Pacific. In 1789 Captain Bligh, having in Tahiti loaded H.M.S. *Bounty* with breadfruit trees, set sail to carry his cargo to its intended destination in the West Indies. In April, while the ship was passing near what we now know as the Tongan islands, the crew mutinied, and cast Bligh and those who remained faithful to him adrift in two small boats. The mutineers turned back

TYPICAL VIEW WITH YOUNG PLANTATION.

the ship and sailed eastward to Tahiti, and eventually—though this was not known till many years later—some of them reached and settled on Pitcairn island. Meanwhile Bligh and the other castaways in their boats landed at an island close to the scene of the mutiny—at Tofua, in the Tongan group. At the first moment the natives, as usual, received the white men, undoubtedly the first they had ever seen, in not unfriendly spirit; but, also as usual, provoked or fancying themselves provoked by the bearing of their strange visitors, turned upon the white men and killed one of them, the carpenter of the *Bounty*, dragging the body of their victim away through the bush along a track on which to this day no herbage has since grown—at least, so the natives now say as they point to the bare path. Bligh and his companions escaped to their boats, and set out on that wonderful boat-cruise past many islands in that unknown sea, including at least one of the Fiji group, to Australia and through the Torres straits, eventually

coming to Timor in the Dutch East Indies, after a voyage of real but involuntary discovery of some 3300 miles.

Nor does this end the tale of discovery in the Pacific due to the incident of the mutiny on the *Bounty*. Bligh's report in England of that incident led to the despatch of H.M.S. *Pandora* to search for the escaped mutineers; and the *Pandora*, after finding and arresting in Tahiti some of those who had returned in the *Bounty* to that island (the others of the mutineers for the time disappeared to Pitcairn), the *Pandora* on her way back discovered, among other islands, Rotumah, to the north of the Fiji group, before she was herself wrecked, in 1791, on the great Barrier reef of Australia.

Discovery in the Pacific may be said to have closed at the end of the eighteenth century. By that time all the larger groups and many of the isolated islands had been visited or at least sighted, though, at any rate as regards the Western Pacific, little had been done as regards permanent settlement by Europeans in those little-known places. It was almost entirely in the nineteenth century that first settlement by vagrant Europeans took place; and it was not till the latter half of the same century that the islands were surveyed and finally annexed by the great powers.

It must be remembered that at the beginning of the nineteenth century—little more than a hundred years ago—all that was known of the Pacific ocean with anything like certainty was certain parts of its Australasian and other main boundaries, and that the countless islands scattered over the vast extent of its water area were for the most part still mere names in the half-remembered tales of the adventurous voyages of the preceding centuries. Not merely from an historical point of view, but for purposes of practical administration, it would be worth a great deal, if it were only possible, to have a clear view of the state and condition of the natives of those half-fabulous islands, as they were a hundred years ago, before European influences had had any permanent effect upon them. Something of the sort, though not a great deal, might perhaps be done by a systematic and comparative study of the many chance glimpses of the natives which have been recorded by the earlier voyagers. But at present—and in the time at our disposal to-night—the only things that can be said are, firstly, that the natives were evidently in a state of savagery, certainly distinct from the state of savagery which has been found to prevail elsewhere in the world, and tempered, especially towards the eastern parts of the Pacific, by a condition of almost idyllic happiness which raised them far above the state ordinarily connoted by the term "savagery;" and secondly, that these natives were, I think in all cases, at first friendly towards their earliest white-skinned visitors, and that it was only when the last-named were, intentionally or unintentionally, in some way offensive to the dark-skinned islanders that the latter attacked the white man.

In the first half of the nineteenth century a considerable and ever-increasing number of Europeans came in various ways into the islands and settled—for more or less reputable reasons—among the natives: fugitives from Botany bay and the other not far distant convict establishments; sailors of ships wrecked—not always without the connivance of the natives—on the coral reefs which fringe the islands; other sailors who deserted from the ships which about that period came into those parts to trade in sandalwood and sea-slugs or to fish for whales; and missionaries who came not merely to convert the natives to Christianity, but in some cases to protect the natives from ill treatment by the white traders and the evil influences of the refugee sailors.

MERELAVA, YAM GARDENS ON MOUNTAIN-SIDE.

The refugees lived for the most part with and under the protection of the native chiefs, and a few of them have left narratives full of information as to the state of the natives. The earliest instance of this kind known to me is that of George Vason, or more probably Wason, a young English bricklayer who, in 1796, caught by the missionary fervour of the period, sailed with many colleagues in the London Missionary Society's ship *Duff* to convert the heathen in the South seas. Wason, with three of his companions, reached Tongatabu, where he became a renegade, took to himself women of the people, and lived as a native, but after four years repented, returned to England, and wrote an authentic narrative of very frank confessions of his doings in Tonga. A few years later (1806) one William Mariner was

wrecked, certainly not without connivance of the natives, on the island of Hapaai, one of the Tongan group, and within sight of the spot where Captain Bligh first touched land after the mutiny of the *Bounty*. Mariner, too, has left a very useful narrative of his life and observations among the Tongans; and he incidentally throws a little light on the early history of Fiji, and especially of the communications of the Tongans with the Fijians. Charles Savage, who lived among the Fijians in the early part of the century and acquired a great influence over them, is chiefly known from the writings of Peter Dillon, the discoverer of the fate of La Perouse. But in some ways the most interesting of all these early Pacific "beachcombers" is Jackson, who many years later, being employed by Commodore Erskine on H.M.S. *Havanah*, was induced to write a considerable but fragmentary account, most vividly interesting and important, of his previous adventures among the Fijians. Jackson obviously gives a truer picture of the Fijians in the earlier part of the century than can be obtained elsewhere.

Missionaries, under the auspices of the London Missionary Society, had entered the Pacific as early as the close of the eighteenth century, and had established themselves fairly well in Tonga by 1830. A few years later they passed from Tonga to the savage islands of Fiji, where cannibalism then prevailed to an extent never at any time elsewhere equalled. It seems probable that in some cases even a few of the white renegades who had settled among the Fijians had joined in this terrible practice. The motive of the missionaries in going to Fiji was to introduce into those dark places Christianity and its attendant civilization, and their success, though naturally slow, was extraordinarily complete, so that within forty years there was hardly an unconverted native left, except in the remote mountainous parts of Fiji.

During this forty years of missionary struggle European settlers of many nationalities, and of a much more respectable class than those who had arrived earlier, began to settle in Fiji; so that by the early seventies there was a considerable European population living as planters and traders, chiefly at certain centres in Fiji, side by side with the Fijians and a quasi-Fijian government which they, the European settlers, had created and bolstered up as well as they could. The greater part of these settlers were of British origin, but there were others, especially Germans and Americans. By this time, too, the Tongans had acquired almost as much power in certain of the Fijian islands as had the natives proper. Lawlessness and insecurity of life and property were naturally rampant. The native chiefs, Fijian and Tongan alike, offered to cede the islands to the British Crown, and the offer—which had been made and approved on a previous occasion—was accepted. Thus in 1874–5 came into existence the one British Crown Colony in the Pacific.

Sir Arthur Gordon, now Lord Stanmore, became the first governor—

at least the first to reside in the islands and to endeavour to introduce some order into the chaos which then prevailed. His success was great —considering the circumstances, very great.

The labour trade in its old and bad form then prevailed over much of Western Pacific, and the conditions under which coloured labour was more or less forcibly transferred from the New Hebrides, Solomon, and other islands to Queensland and Fiji had led to many abuses. The Governor of Fiji was made High Commissioner over all the parts of the Pacific where British influence had become in any way active, and perhaps the best of all the results of this move was the suppression of the evils of the labour traffic.

COAST AT DORIG-SANTA MARIA.

I went to Fiji in 1904 in the dual capacities of Governor of that Crown Colony and High Commissioner of the Western Pacific, *i.e.* with control, on behalf of the Secretary of State for the Colonies, of all the British possessions and protectorates in the Pacific, with the exception of the few small islands attached to New Zealand (chiefly the Cook islands) and the few still smaller islands adjacent to and dependent on Australia.

A glance at the map will show that my charge is geographically centred in the Fiji islands, which, it may now be understood, are historically, as well as for practical administrative purposes, the natural centre of British rule in the Pacific. It is convenient, for descriptive purposes, to think of the Fijian islands, with the dependency Rotumah, as the centre of a great circle including the Tongan or Friendly islands, the Ellice and Gilbert groups with the Union and Phœnix islands, Ocean island, Ongtong Java (otherwise called Lord

Howe island, or Leueuna), the Solomon islands (exclusive of the northernmost of the chain, *i.e.* Bougainville), the Santa Cruz islands, and—though these latter are subject to joint French rule—the Banks and Torres islands and the New Hebrides. It must be remembered that I have mentioned only the most important islands under British influence, and that in the great group comprised within this circle there are unnumbered islets nominally subject to British influence, and that—to look at the thing for a moment merely from a geographical point of view—there are, intermingled with the British, many French possessions, *i.e.* to the south of the New Hebrides, the important and compact group constituted by New Caledonia, with the Isle of Pines and the Loyalty islands, and, far away to the north of Fiji, the tiny islands known as Wallis and Fotuna.

Again, outside this great circle of chiefly British influence in the Pacific there are very many tiny and more or less insignificant British islands under my charge as High Commissioner, notably the small group very far to the west, of which Pitcairn island is, at least for historical reasons, far the most important; and, to the north of Tahiti, another group of still less important islets, of which Flint island, visited by a recent eclipse expedition, is, for that reason, perhaps the least unknown; and yet another group, of which by far the most important is Fanning island, a station of the Pacific Cable Boards telegraph line between Australia and Vancouver.

I am not myself sure whether the description which I have now given covers all that, theoretically at least, falls under the charge of the British High Commissioner—but there cannot be many omissions, or indeed any of importance. It may be well here, parenthetically, to observe that my islands, together with the New Zealand and Australian islands already alluded to, cover also the sphere of British influence over the islands of the Pacific.

It may save time if I here condense all that I can now say of the geological nature of the various islands—really a most interesting subject, on which much has been written by Agassiz and others. Briefly and generally, all the islands and reefs under consideration are, doubtless, either the tops of the higher mountainous parts of the area covered by the Pacific ocean, or are the coral formation which has grown on such of the mountain-tops as are more or less submerged. To one voyaging on the Pacific, this geological theory accounts for the main forms of all the islands and reefs which he sees. It accounts for the high rocky islands, with or without an obvious coral fringe, which he sees; it accounts for the lagoon-encircling coral reefs which he sees often barely awash, but sometimes with the higher parts rising into islands a few feet above water; and it accounts for the isolated islands, such as Ocean island, and for the long chains of island such as the range formed by the Solomon and New Hebridean islands.

I cannot here deal in detail with each of the islands which I have visited, but I propose to describe chiefly a tour of the main circle of islands which I made from Fiji in 1904 and 1905 in H.M.S. *Clio* and H.M.S. *Torch*, my impressions of that tour having been confirmed by many subsequent voyages in men-of-war.

The Tongan islands, or, as Captain Cook called them, the Friendly islands, lie some 400 miles to the south-west of the Fijian islands, the two groups being more or less connected by intervening islets. The Tongan group—on a much smaller scale than the Fijian—is formed by the exposed tops, mostly flat and low, of a mountain chain extending from Eua in the south to Vavau in the north. The main islands forming this long chain, from south to north, are Eua, evidently volcanic

CORAL FORMATION.

and high, well wooded, and containing the only stream of fresh water in the group; Tonga-tabu, or Sacred Tonga, of which I shall have more to say presently; Anamu, the scene of many of Captain Cook's adventures; Hapaai, on which Mariner was wrecked; Tofua, an active volcano on which Captain Bligh landed and his carpenter was slain; and Vavau, a high island with a splendid land-locked harbour, somewhat difficult of entrance, and somewhat too deep for good anchorage.

In Mariner's time, and probably earlier, the Tongans were in fairly frequent communication with the Fijians, a communication favoured by the intervening islands and by the prevailing winds. At that time—if Mariner is to be believed—the Fijians were the stronger race, and were teaching the Tongans the two important arts of fighting and of boat-building. Subsequently the Tongans, who came much earlier under the sustained influence of Europeans, and have always assimilated that influence much more strongly, used the new knowledge which they had

gained both from Europeans and Fijians to gain power in Fiji. That is the explanation of the fact—of some importance in Pacific politics—that at the time when Fiji was ceded to Britain the Tongans were so much the stronger race that they, more than any other of the native races of the Pacific, succeeded in maintaining their independence in the face of the growing European power.

The "king" and the "kingdom" of Tonga and its "constitution" still survive, though now under a very strong British Protectorate. There is a parliament, a cabinet, a state church, an elaborate system of higher education—but all these institutions work under the kindly and protecting care of the British Government. The situation is, I think, unique. How it has come about—at least, how all but the final stages came about—may be read in Mr. Basil Thomson's instructive and most amusing book, 'The Diversions of a Prime Minister.'

Leaving the Tongan islands, we passed north-east and slightly westward—thus just avoiding the Samoan islands, the possession of which is divided between Germany and the United States—up along the chain of the Ellice and Gilbert islands which form a separate British Protectorate, proclaimed in 1892. Each of the groups constituting this Protectorate is composed of a considerable number of very well defined coral atolls, the surface of which nowhere rises more than a few feet above the level of the water. These isolated habitable spots scattered over the ocean are very minute, hardly any of them with a total area of more than a few miles. Some soil has somehow accumulated on these—enough to induce the densest growth of coconut palms that I have ever seen, and a considerable number of screw pines (*Pandanus*)—but there is hardly any other natural vegetation and very little introduced vegetation, except a few breadfruit trees and a little taro, both of which food plants are there cultivated with extreme difficulty.

Much as the coconuts and the screw pine fruits must both have been wind and water borne to these islets, so must the natives have originally come. Whence they came it is very difficult to say; as to when they came, all that, I think, can be said is that they must have come very long ago, judging from the peculiar characteristics which mark them off from other groups of natives. They were, when first they became known to Europeans, at a distinctly low stage of social development—far below that common in the Eastern Pacific and in Samoa and Tonga. The natives of each islet, or at any rate of each group of islets on a single atoll, were self-contained, *i.e.* had little to do with the natives of any other islet, except to fight them. Probably in those early days the fruit of the screw pine—prepared as a sort of rough flour—and the fish which abound in the deep seas from which these coral rocks rise, were their chief food, for it seems probable that the coconut palm, at any rate in its present great abundance, is a later development.

In these islands too the earliest European settlers were waifs and strays of many nationalities—but perhaps chiefly British and American—who somehow established themselves among the natives, chiefly by assisting one set of natives against the others. Many vivid pictures of their old "beachcombing" days in the Gilbert and Ellice islands may be found in the travellers' books of the middle of the last century, in the Admiralty records, and, in more accessible form, in the delightful and very true tales of Mr. Louis Becke.

It was in the beachcombers' days of the middle of the last century that the Gilbert and Ellice islands were largely exploited for the "labour trade." In this case, however, the natives were carried off chiefly to the Pacific coasts of South America rather than to Australia; and the custom of the trade differed from that followed, say, in the New Hebrides and Solomons, in that from the Gilberts the natives seem to have been sold by their own native chiefs through the resident beachcombers to the recruiters, whereas in the islands nearer to Australia the natives were undoubtedly often merely kidnapped. But as far as the interests of the natives were concerned, the system in the Gilberts was obviously as cruel and destructive as that which prevailed elsewhere.

It was to put an end to the constant and inhuman internecine war which prevailed in these islands, and to end also the pitiless labour traffic, that Great Britain in 1892 proclaimed a protectorate over the Gilbert islands, and, a year or so later, also over the Ellice islands. A resident commissioner was put in charge—under the High Commissioner—and a very fair degree of law and order was introduced. The results have been most excellent, as far as the peace and happiness of the islanders are concerned. The labour traffic has practically ceased, except that natives occasionally go of their own will, and no longer at the absolute will of their chiefs, to one or two more or less adjacent islands, Ocean island and Fanning; but even in this case they go under careful supervision by the resident commissioner, and under strict precaution as to good treatment and safe return. It cannot be said that, except in one respect, the trade and consequent wealth of these islanders have increased. The exception is that, as I have already indicated, the growth of coconuts has largely increased; but coconut-growing, at least as practised in native communities, implies less labour than probably any other form of cultivation, and most certainly does not offer any adequate outlet for the energies which were formerly devoted almost exclusively to the fighting, now, of course, strictly prohibited. Unfortunately, the physical character and the remote situation of these islands make the development of any new industry and occupation for the islanders difficult and perhaps impossible. Consequently, it may fairly be said that British administration in these islands has been highly successful in promoting the peace and

bodily welfare of the natives as individuals, but, even in so doing, has inevitably stopped the natural outlets of energies which helped to keep the race going. The position illustrates a curious difficulty which awaits, and will possibly always await, solution by powers which attempt to administer "savage" people by civilized means.

Almost due east from the Ellice islands lie two small but distinct groups of British islands—the Phœnix and Union islands, which are at present under the charge of the British Resident in Tonga, but might conveniently be attached for administrative purposes to the Protectorate which we have just been considering.

Due east of the Gilbert islands, and just below the equator, lies a pair of islands, Ocean island or Paanapa and Pleasant island or Nauru, over which—or at least over one member of which—I must linger for a few minutes. One of these islands, Pleasant island, is German; the other, Ocean island, is British; the two are, however, not only adjacent, but are very similar to each other, and alike carry enormous deposits of very valuable phosphate rocks. The political history of these two small mountain-tops rising together in a lonely sea is a detail in an event interesting in the modern history of the Pacific. Both had been successfully exploited for phosphates, the one by Germans, the other by Britishers, and in each case the hitherto unknown and undeveloped natural wealth of the island was, with the goodwill of the natives, taken in hand by the respective discoverers. Then, in 1899, the Samoan agreement was made between Great Britain and Germany and (though this does not affect my present story) the United States of America. Thereby Germany *inter alia* consented to limit her considerable sphere of influence in the north-west Pacific by a line which, starting eastward from the southernmost point of the coast of German New Guinea, runs through the northern Solomon islands in such a way as to leave to us all except the two northernmost of these islands, and then runs north-west in such a way that Germany retains Pleasant island, and we retain Ocean island. It is unnecessary at this moment to follow this international line further, except to point out in passing that as a whole it forms the eastern boundary of the great German sphere in the Pacific, including a great part of New Guinea, together with New Britain and New Ireland, the Caroline and Marshall islands.

Ocean island is small, rocky, and scrub-covered, and at the time that it came into European ken had but few inhabitants, obviously of a different race from those of the 400-miles distant Gilbert islands, and there was little or no communication between the two groups. The company which eventually obtained rights, to my mind perfectly legitimately, over this island has turned this desolate, almost uninhabited, and quite useless rock in the ocean into a busy centre of industry, from which large quantities of phosphates are exported to

Japan, Europe, or elsewhere. The few natives have prospered greatly under the employment thus afforded to them. For a time large numbers of Gilbert islanders came voluntarily to work on Ocean island; but these, having by their work acquired more money than they knew what to do with, have for the most part returned to their original homes. They have been largely replaced on Ocean island by Japanese. It should be quite clearly understood that Ocean island has no more to do with the Gilbert and Ellice islands than with any of the other Pacific islands, except that it happens to be under the charge of the same Resident Commissioner.

After leaving Ocean island we visited Ongtong Java, one of the

ONGTONG JAVA VILLAGE.

earliest known but still least-known of Pacific islands. It is a circular atoll, I think some 25 miles in diameter, but there are only three or four tiny coconut-clad islets on the whole extent of its more or less submerged reef. Its people are more or less distinct in language, physique, and habits from those of any other islands. When I visited the place, only four years ago, and necessarily for a very brief time, it was quite evident that the original conditions of native life prevailed here to a degree unusual, if not unprecedented, elsewhere in the Pacific. But the copra traders have since pushed their business further, and if any ethnologist wishes for a good opportunity of studying native life he should go to Ongtong Java without delay.

From Ongtong Java our course lay south-west to the long chain which, though lying at a great distance from the northern part of the

western coast of Australia, yet in a striking way follows the contour of that coast. The chain includes the Solomon islands, with the Santa Cruz group, and the New Hebrides. We struck the Solomon islands at Bougainville straits, which separate the two northernmost islands of the Solomon group, *i.e.* Bougainville and Buka, from the rest of the chain. Under the Samoan agreement of 1899, already referred to, Bougainville and Buka were definitely assigned to Germany, while all the rest of the Solomon islands, with those of the Santa Cruz group, fell to the British share. The New Hebrides, with which are included the Banks and Torres islands, are, I need hardly explain, under the joint protection of Great Britain and France. There is a resident commissioner—a deputy of the High Commissioner—in the Solomons, and another in the New Hebrides.

An enormous number of distinct tribes of natives, of very uncertain history and origin, occupy this long chain of islands, in many of which there is still much unexplored land. These natives are, and have always been, at a very low stage of civilization as compared with those of the eastern parts of the Pacific, of Tonga, and even of Fiji. A considerable number of settlers and of missionaries have long been settled at many isolated spots in most of the larger islands of the chain; and from these islands also most of the coloured labourers, so-called Polynesians or Kanakas, who during a large number of years have been used in Queensland and Fiji were taken. Formerly there was, no doubt, much cruelty in this labour traffic; but in the seventies British legislation on the subject was put in force, and there cannot be any reasonable doubt that the evils were from this fact greatly checked—and were, indeed, long ago practically stopped. Indeed, the labour trade itself has now practically stopped, Australia having abjured the use of coloured, introduced labour, and Fiji having, somewhat unwillingly to a great extent, substituted East Indian for introduced Polynesian labour.

In the British Solomon islands, European enterprise has latterly very greatly developed, and the plantations of Messrs. Lever Brothers, Messrs. Burn, Phelps & Co., and others, have there made a great change in the situation. The sudden influx of Europeans among natives, many of whom are as yet hardly touched by civilization, has unfortunately but naturally led to friction, for which, in justice to both, it must be said that sometimes one party, sometimes the other, are to blame. The position of white men settling in places and among natives more or less unknown is a dangerous one, and no one should place himself in such a position without duly considering the risks which he must accept. A very fair start in administration and the introduction of law and order, both among Europeans and natives, has been made, chiefly owing to the Resident Commissioner, Mr. Woodford.

The history of European settlement in the New Hebrides has been, to a certain extent, similar to that of the Solomons; but in the case of

the southern group, the development of the early stages of administration were long checked by the conflict of British and French claims. That conflict has now been replaced by mutual understanding and co-

CEMETERY, ONGTONG JAVA.

GAVUTU AND TULAGHI, FLORIDA.

operation. The joint Anglo-French convention as to the New Hebrides is an experiment without precedent, and one of extreme delicacy. I believe that it may bring about prosperity in those hitherto somewhat

distracted islands. At the bottom of the chain of the New Hebrides lie the important islands of New Caledonia and the Loyalties, both French possessions, the existence of which makes the value of the New Hebrides to the French. Leaving these last-mentioned islands behind us our course now took us back to headquarters in Fiji.

I have now described, as well as time allows, the British possessions in the Pacific, all of which are, roughly speaking, centred round Fiji, and most of which are, despite their great distances, administered from Fiji. These island possessions are a part of the Empire which must in the near future attain greater and greater importance. They are, I believe, already gradually consolidating and preparing eventually to take their natural place as a part of the great Australasian member of the British Empire.

The PRESIDENT (before the paper): We welcome here to-night one who has been for many years a Fellow of this Society, Sir Everard im Thurn. His first experiences in tropical life and tropical geography were in British Guiana, where he lived for something like twenty-two years, from 1877–1899. During those years he contributed a considerable number of papers to the Society. His first paper, on the interior of that colony, appeared as long ago as 1880. It was followed by a considerable number of other communications—one on the ascent of Mount Roraima, and another on the north-western districts of British Guiana. After leaving that colony he went to Ceylon, where he was Colonial Secretary and Deputy-Governor, and from Ceylon, he has passed on to be Governor of Fiji and Commissioner of the Western Pacific, a post which he now holds. You see, therefore, that he has had a wide experience in many parts of the British Empire, and you may feel sure that he has not been idle even in matters geographical in his new post. We shall, therefore, I am sure, all listen with the greatest interest to his account of these remote islands, and I will, therefore, at once call upon him to be kind enough to address us.

After the paper, Mr. BASIL THOMSON: Sir Everard im Thurn just now invited any one who could to rise and explain the etymology of the word *kanaka*. Well, I am not sure that I am an authority upon the matter, but I would suggest *tangata*; the *t* and the *k* are interchangeable all over the Pacific, and I believe the word to be *tangata*, which is in Fijian *tamata*, which simply means "man." I am very grateful to Sir Everard for dealing first of all with the history of exploration. There is no other page in the whole of the history of geography that is so full of mystery and romance. He mentioned two or three Spanish voyages, but omitted two of the most suggestive. In 1527, Cortes sent de Saavedra with three vessels to discover the islands of gold. You must remember that to the Spaniards the whole horizon was yellow. There were already traditions in Mexico that to the west lay an island of gold. Two of the vessels parted company and were never afterwards heard of, but in the native traditions, a foreign vessel was wrecked on the island of Keei about 1527, if you count by generations, and two white men were saved, and, according to the native traditions, these two white men were the ancestors of chiefs who are living to-day in Keei. Ten years later Grijalva sailed with three vessels. Illustrative of the difficulties the Spanish navigators had, two of them mutinied, and the third vessel was eventually wrecked, but not before they discovered the Marshall group, and that was proved by the fact that Mendaña found an iron nail in a deserted house that could only have come from that expedition. Next and most important of all was the voyage of Villalobos in 1542, and it is important

in this way. We have always been accustomed geographically to ascribe the discovery of the Sandwich islands to Captain Cook. In the Colonial Office at Madrid there is a half-manuscript chart in which the Sandwich islands appear correctly placed with the title of Isles de Mesa (Table islands). There is almost no doubt that he really discovered the Sandwich islands.

The interesting part of Mendaña's voyage is this. He discovered the Solomons, and he described them so accurately that you can recognize every bay and headland; he described the natives so accurately that we have been able to identify, out of a considerable vocabulary, all but ten words; that during the three hundred years that have intervened, scarcely a change has been made in the customs, dress, and language of the natives. Of course, the old idea of sociology is that if you plant a race and give it time it either progresses or retrogresses, but in the case of the Solomons the people have remained absolutely stationary. The Solomons were lost for two hundred years, and the interest then shifted to the study of M. Buache. There was a great controversy, and M. Buache, a French geographer, had the honour of establishing without doubt that they were identical with the islands discovered by Surville in 1768. Sir Everard mentioned that he thought all the earlier voyagers had been received with open arms, but there were exceptions. Cook, if you remember, named "Savage island" so because the natives attacked him "with the fury of wild boars." I agree cordially with Sir Everard that Ongtong Java should be studied before it is too late. It is a museum of Polynesian institutions of the old time. I can only thank Sir Everard for the remarkably interesting paper he has read.

Mr. Henry Balfour: The scientific interest of the Pacific area is extremely great, not only from a geographical standpoint, but an ethnological one. The region of the South Pacific certainly bristles with problems which are still waiting solution, for which the material is rapidly disappearing. One can only hope that during Sir Everard im Thurn's tenure of the high position he holds at present he will make every endeavour to further ethnological investigation in the Pacific area. It is not only the problems which are associated with the living natives with which we should concern ourselves, but there is also the archæology of the Pacific. We want to know something about those races which have disappeared, and have been supplanted by later ones. I hope Sir Everard will carry out his intention of visiting Pitcairn island. In addition to the comparatively mild interest associated with the mutiny of the *Bounty*, there is in Pitcairn island a most interesting problem associated with the archæology of the island which still awaits solution. The very specialized stone implements found there have not yet been diagnosed successfully and assigned their true ethnological position. Those which have been discovered are so peculiar that they cannot be associated with any other part of the Pacific, and seem to point to some entirely different element in the culture. This is only just one of the problems which occurs to me as coming within the sphere of influence of Sir Everard im Thurn. He is undoubtedly specially qualified to assist in elucidating complicated problems in this region. It is not so much that he holds two important positions, that of Governor of Fiji and High Commissioner of the Western Pacific, but it is also that he has that sympathy with native life which is necessary for its study. He is essentially in sympathy with the natives, and has already shown a deep interest in their habits and customs. It was this interest, no doubt, which led him a quarter of a century ago to publish a work on the natives of British Guiana, a work which immediately became a classic in the ethnological literature of that region, and which has remained a classic ever since. One can look to him, I am sure, for the furthering of ethnological investigations in this region, and can only wish him success.

The PRESIDENT: I am sure, in your name I may thank Sir Everard im Thurn for his admirable lecture, and wish him also good luck on his voyage out, good luck in his return to the country which he is to administer—a country where the inhabitants, as I say, seem to me happy in temperament, happy in climate, happy in the government under which they live, and also, I think, happy under the governor under whom they live. In your name, I am sure, I may thank him heartily for his lecture to-night.

FURTHER ANTARCTIC REPORTS OF THE EXPEDITION OF 1901–1904.*

By Prof. J. W. GREGORY, F.R.S.

SINCE the publication in the *Geographical Journal* of July, 1908 (pp. 25–47), of a classified guide to the scientific results then published by the National, Scottish, German, and Swedish Antarctic Expeditions, much additional material has been published by the four Expeditions.

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* 'National Antarctic Expedition, 1901–1904.' Natural History, vol. 4. Zoology (Various Invertebrata), 1908, v. + 281 pp., 38 pls.; Physical Observations with Discussions by Various Authors, 1908, v. + 192 pp., 21 pls., 2 maps; Album of Photographs and Sketches, with a Portfolio of Panoramic Views, 1908, xvi. + 303 pp., 165 pls. [Pls. cxxix.–cliii. in the separate portfolio and 2 maps.]

'Deutsche Südpolar Expedition, 1901–1903.' Edited by E. von Drygalski. Vol. 1. Geographie, part ii.: E. von Drygalski and J. Domke. Zeit- und Orts-Bestimmungen, nebst erörterungen über die Meer- und Eisfahrt des *Gauss*, 1908, pp. 97–281, pl. xiv. Vol. 2. Kartographie, Geologie, part ii.: E. Werth. Aufbau und Gestaltung von Kerguelen, E. Philippi; Geologische Beobachtungen auf Kerguelen, R. Reinisch; Petrographische Beschreibung der Kerguelen-Gesteine, 1908, pp. 89–222, pl. ix.–xxii. Vol. 2. Geographie, Geologie, part iii.: E. v. Drygalski; Geographie von Heard-Eiland, E. Philippi; Geologie der Heard-Insel, R. Reinische; Gesteine der Heard-Insel, E. Vanhöffen; Tiere und Pflanzen der Heard-Insel, W. Meinardus; Skizze des Klimas der Heard-Insel, 1908, pp. 223–298, pl. xxiii. Vol. 6. Erdmagnetismus, II. Band, part ii., K. Luyken; Die Absoluten Erdmagnetischen Beobachtungen der Kerguelen-Station, 1908, pp. 75–187, pls. vi.–xii. Vol. viii. Botanik, part ii., Th. Reinbold, Die Meeresalgen; M. Foslie, Die Lithothamnien, 1908, 177–220, pl. xx. Vol. 9. Zoologie, I. Band, part vi., C. G. Attems; Die Myriopoden, A. Reichenow; Vögel des Weltmeeres, 1908, pp. xii. + 415–568, pl. xliv.–l.

'Scottish National Antarctic Expedition.' Report on the Scientific Results of the Voyage of S.Y. *Scotia* during the Years 1902, 1903, and 1904, under the Leadership of William S. Bruce. Vol. 4. Zoology, part i.: Zoological Log, D. W. Wilton, J. H. Harvey Pirie, and R. N. Rudmose Brown, 105 pp., 33 pls., 2 maps.

'Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition, 1901–1903, unter Leitung von Dr. Otto Nordenskjöld. Vol. 3, part ii., 1907, J. G. Andersson, Contributions to the Geology of the Falkland Islands, 38 pp., 9 pls. and maps. Vol. 4, part vii., 1908, E. Ekelöf, Bakteriologische Studien während der Schwedischen Südpolar-Expedition, 1901–1903, 120 pp., 1 pl. Vol. 5, part ii., 1907, I. Trägårdh, The Acari of the Swedish South Polar Expedition, 34 pp., 3 pls., 56 figs. Vol. 5, part x., 1907, K. A. Andersson, Die Pterobranchier der Schwedischen Südpolarexpedition, 1901–1903, nebst Bemerkungen über *Rhabdopleura Normani*, Allman, 122 pp., 8 pls. Vol. 6, part i., 1908, H. Strebel; Die Gastropoden, 111 pp., 6 pls. Vol. 6, part ii., 1908, F. Richters, Moosbewohner, 16 pp., 1 pl.

The later contributions include the physical results of the British and Scottish Expeditions, and some of those of the German Expedition, a further series of biological memoirs, and contributions to the geography and geology of Kerguelen, Heard island, and the Falklands. The British meteorological results have also been issued and recently reviewed by Dr. H. R. Mill (*Geogr. Jour.*, vol. 33, 1909).

Physical Observations.

The physical observations made by the National and Scottish Expeditions are issued in a volume prepared under the superintendence of the Royal Society, and introduced by a preface by Sir Archibald Geikie. The volume includes the results of the tidal, pendulum, earthquake, auroral, and magnetic work. The tidal observations are discussed by Sir George Darwin, aided, for the observations of the *Scotia*, by Messrs. Selby and Hunter. Sir George Darwin explains that the results obtained by the *Scotia* are quite normal; and that in the areas of observation by both expeditions the phase of the diurnal tide is approximately the same as is required by the equilibrium theory, but that the diurnal tide as measured by the *Discovery* at Ross island is greater than at the South Orkneys. This difference he regards as at present inexplicable. The pendulum observations in South Victoria Land were made by Mr. Bernacchi and Lieut. Skelton, and their observations are discussed in a report by Dr. Chree, who states that the results are as consistent as could be expected under the conditions of observation. Dr. Chree refers to four elements of uncertainty in the results, but they do not seem to throw doubt on the conclusion that the value of g on Ross island, as has been already well established for Melbourne and New Zealand, is slightly above the theoretical value. The most surprising feature of these observations is that the value of g is recorded as being different in winter and summer. If this be due to errors of observation, Dr. Chree thinks the mistake can only be in the rates of the chronometers, the determination of which does appear to have been altogether satisfactory. But Dr. Chree suggests that the observations may be correct, and the anomalous result an effect of the removal of ice from the Ross sea during the summer.

The National Expedition had an excellent equipment for earthquake records, which was under the care of Mr. Bernacchi. The results are recorded and discussed by Dr. Milne. As the large earthquakes were not felt by the observers personally, they must have originated at some greater distance than 50 miles. Among the most interesting of the seismological results was the discovery that many of these shocks originated from an earthquake centre between New Zealand and South Victoria Land. Dr. Milne gives a list of earthquakes widely felt in the northern hemisphere, which, in spite of their power, were not recorded by the instruments. Dr. Milne explains this fact by the initial blows

of these earthquakes having been given east or west, so that the shock travelled round the world in the northern hemisphere, but died out more quickly to the south. In many cases an earthquake was observed both by the *Discovery* and in Europe, but not in intermediate positions; the reappearance of these earthquakes Dr. Milne attributes to the focussing of the vibrations in the Antipodes.

The auroral observations are described by Mr. Bernacchi. They were made by all the members of the expedition during their meteorological watches, and they are illustrated by a series of beautiful plates from sketches by Dr. Wilson. The methods and equipment used in the magnetic observations are briefly described by Mr. Bernacchi, who was the chief magnetic observer; the report on this branch of the work is by Commander Chetwynd, who concludes, amongst other results, that the declination is increasing 26′ annually, and that the position of the south magnetic pole is 72° 51′ S. and 56° 25′ E.

The German Expedition has issued a further instalment of the two volumes dealing with its observations on terrestrial magnetism, and it includes the statement by Herr Luyken of all the observations made to determine the absolute declination, horizontal intensity, and inclination at a station erected at Kerguelen. It includes also a short description of the observatory established for the absolute measurements, supplementing the account published in the first part of the magnetic volume.

Geography and Geology.

The German Expedition has issued a series of important contributions to the geography of Kerguelen and Heard islands. The Expedition established a fully equipped magnetic and meteorological station at Observatory bay, Kerguelen, to serve as a base of reference for the observations made by the *Gauss* during its voyage to the south. The staff of this station made good use of their opportunities for the study of the geography, geology, and biology of the adjacent parts of Kerguelen, while during the stay of the *Gauss* in Observatory bay, both Dr. Drygalski and Herr Philippi, the geologist, investigated the physical geography and geology of the immediate neighbourhood. Although Kerguelen was discovered in 1772, and its insularity proved by Cook in 1775 and the visits of numerous scientific expeditions, the interior and the western coast are still comparatively unknown. Dr. Werth, who lived on the island at the German station from 1901 to 1902, had therefore ample scope for new explorations; but his range of research was limited by difficulties of transport and the necessity of attending to the work of the station. Nevertheless, he was able to make numerous excursions and show the general structure of the south-eastern part of the island.

Three hundred and thirty miles south-east of Kerguelen is the less-known Heard island, to which the German Expedition paid a visit, and

in the statement of its own contributions it has incorporated all existing knowledge of the geography, geology, biology, and meteorology of the island. Minardus has supplemented the scanty observations on the climate by interpolation between the contemporary records of the station at Kerguelen and those made on the *Gauss*.

Heard island and Kerguelen are both part of the same sheet of volcanic rocks, and rise from the same submarine plateau. No continental rock has yet been found on either island; they both consist mainly of basalts and other basic volcanic rocks, with some scarcer and older acid lavas. These acid rocks, the trachytes, are relatively more abundant on Heard island than in the parts of Kerguelen at present explored. The only sedimentary rocks on the islands are volcanic rocks and redeposited material, a bed of which on Kerguelen has yielded some fragments of the stem of the conifer, Cupressoxylon. This genus has, however, so long a geological range that it gives no precise date for the Kerguelen eruptions; but it is probable either that they all belong to the present geological system, or that a part may be somewhat older. They are Pleistocene, and perhaps partly Pliocene. None of the volcanoes have been known to be active, but the Ross crater is obviously of recent age.

The physiography of Kerguelen is of much interest. There is no convincing evidence of its recent greater elevation, as, though marine shells were found up to 300 feet above sea-level, they may have been carried inland by sea birds. On the other hand, clear evidence of the recent submergence of the land is afforded by the drowned valleys of south-eastern Kerguelen.

The National Expedition has issued a superb album of photographs and portfolio of sketches made by its members.* This is work of general interest, but it contributes mainly to the geographical evidence collected by the expedition. The chief contributors to this series are Dr. Wilson and Lieut. Eug. Skelton, and their artistic skill added greatly to the value and beauty of the records of the expedition. The album is introduced by a preface by Sir A. Geikie, who explains the preparation of the volume. The plates are described by Dr. Wilson, who acknowledges his indebtedness to notes supplied by Captain Scott and other members of the expedition. The illustrations deal with the scenery and topography, and give most graphic representations of the area of operations. Dr. Wilson's sketches of the land seen along the southern sledge journey and Lieut. Skelton's panoramas of scenery around the winter quarters are both contributions of high permanent value to Antarctic geography. The collections include a good series of zoological illustrations, but those of the ice and of the rocks are not so numerous or detailed as might have been wished.

* See also p. 334.

Dr. Gunnar Andersson has prepared a memoir on the geology of the Falkland islands, mainly, he tells us, as a guide to T. G. Halle, who has gone to the Falkland islands and Tierra del Fuego to continue their geological exploration. Dr. Andersson gives a short summary of previous work on the geology of the Falkland islands, which was begun by Darwin and continued by Sir Wyville Thompson on the visit of the *Challenger*. The Devonian fossils obtained by the *Challenger* Expedition were described by Etheridge. Dr. Andersson's specimens are assigned, in a preliminary report by Prof. Kayser, to the Lower, and perhaps also to the Middle, Devonian age. The most important discovery was of some fossil plants identified by Dr. Nathorst as *Phyllotheca*, and belonging to the *Glossopteris* flora; so there can be no doubt that the sandstones that contain these fossils are of Upper Palæozoic age.

Most of the report is occupied by an account of the stone rivers, which were described by Darwin; but his explanation is dismissed now as only of historic interest. Sir Wyville Thompson's explanation is satisfactory, and it led Prof. James Geikie to the inference that these stone rivers indicate a change in climate. Dr. Andersson independently arrived at the same conclusion. He explains the stone rivers as due to the flow of boulders down slight slopes when embedded in soil saturated with water. This slow soil-cap flow Dr. Andersson has previously named solifluction. Subsequently the soil has been washed away by water action, and the boulders left scattered over the surface. Dr. Andersson points out clear evidences of glacial action on the islands, and shows that they have undergone several changes of level in recent geological times. In pre-glacial times the land was between 150 and 240 feet higher, and the archipelago was then practically one large island. At the time of the glaciation the level of the land was the same as it is to-day; but subsequently the islands have been submerged to the height of from 200 to 350 feet. Dr. Andersson's valuable report is accompanied by some excellent photographs; especially noticeable is a large panorama of the Darwin stone river, which is also illustrated by a geographical map.

Biology.

A further instalment of the zoological results of the National Expedition is contained in the fourth volume of the 'Natural History Reports,' which is devoted to various invertebrates. The volume is edited by Prof. Bell. Dr. Nierstrasz describes an additional species of mollusc belonging to the interesting genus *Proneomenia*, of which the few known species are almost world-wide in distribution. Dr. Nierstrasz takes the opportunity, in describing the new species, of reclassifying its family, the *Promeomenidæ*.

Prof. G. H. Carpenter describes the one Antarctic insect found by the expedition, a species of the wingless insects, the *Collembola*, of which

six species were collected by Mr. Hodgson, after whom the species is named *Gomphiocephalus hodgsoni*. It is not quite the first insect found on the Antarctic continent, as Prof. Carpenter had previously described a species of *Isotoma* obtained near Cape Adare by the "Southern Cross" Expedition.

A collection of Schizopods, including over ten thousand of one species and smaller series of twelve others, has been investigated by Mr. W. M. Tattersall. Ten of the species were obtained in Antarctic seas. The material described is in excellent preservation. The great bulk of the material belongs to one species, *Euphausia crystallorophias*. All the known genera of Antarctic Schizopoda are also found in the northern seas, but there is not one species common to the two Polar seas.

The Copepods are described by Dr. R. M. Wolfenden. Though the species obtained were few, as is common with Polar faunas, individuals are very abundant. The *Discovery* obtained nine new species; the number of species in its collection is much less than was obtained by the *Belgica* or the *Gauss*, both of which collected from a wide range of localities, while all the British material was obtained at the winter quarters by Mr. Hodgson's dredging through holes in the ice. Dr. Wolfenden refers to the question of bipolarity, and says there is little resemblance between the characteristic Copepod fauna of both Polar Regions.

Prof. Bell, the editor of the zoological Reports, himself contributes the memoir on the Echinoderma, of which the most striking feature was the rediscovery, also made by the *Gauss*, of *Promachocrinus Kerguelenensis*, one of the most remarkable of the new animals discovered by the *Challenger* Expedition. The most interesting of the star-fish is made the type of a new genus, happily named *Heuresaster hodgsoni*, from *euresis*, "discovery," and after the biologist of the expedition. The collections included numerous Ophiurids, of which, however, all the species were previously known.

Prof. MacBride and Mr. J. C. Simpson contribute an interesting memoir on the Echinoderm larvæ, and Dr. R. von Stummer-Traunfels has a long report on the Myzostomidæ. The collection obtained two species, of which one is new. The expedition collected thirty specimens of Sipunculoidea, which are described by Mr. W. F. Lanchester, who refers them all to one species, *Phascolosoma socium*. The sea-anemones are described by Mr. J. A. Clubb. About fifty specimens were obtained, including those collected at the Falkland and Auckland islands, and two new species found at the Winter Quarters of the expedition.

The volume concludes with two memoirs on the rich sponge fauna of the Antarctic seas; the Tetraxonids are described by Mr. Kirkpatrick, and the calcareous sponges by Mr. Jenkin. The structure of these sponges and the forms of their spicules are shown in detail in a series of unusually beautiful plates, including some figures by Prof. Minchin,

who began the report on the Calcarea. The fifty-nine specimens of Tetraxonids belong to four species, and the one hundred and nine specimens of calcareous sponges are divided into twenty-three species, of which no less than twenty are new, and six represent new genera.

The large zoological collections of the Scottish Expedition are still in process of description, and the only complete further section issued is vol. 4, part i., the "Zoological Log" of the expedition, by Messrs. D. W. Wilton, J. H. Harvey Pirie, and R. N. Rudmose Brown. It is a handsomely illustrated volume of 105 pp., with two maps and thirty-three plates containing a large series of zoological photographs, many of which, such as the Portuguese man-of-war in various positions assumed in life, and the giant cuttlefish photographed lying on the snow by the Winter Quarters in the South Orkneys, are of much interest. It has a coloured frontispiece of three Emperor penguins inspecting a couple of Weddell seals. The text of the volume shows the systematic care and untiring persistence by which the expedition secured its rich zoological harvest.

The results of the Swedish Expedition include four additional contributions to its zoological results. The first of these is an important monograph by K. A. Andersson of Upsala, on the Pterobranchs, one of the most interesting elements in the Antarctic fauna. The Swedish Expedition obtained *Cephalodiscus* at six stations, three Antarctic and three sub-Antarctic. The specimens are referred to six species, only one of which was previously known. One of the new species is referred to Dr. Ridewood's subgenus *Demiothecia*, founded on specimens obtained by the *Discovery*. Andersson also founds an additional subgenus, *Orthœcus*, based on three new species found in the Graham Land region. The new species are fully described and illustrated. The plates include a coloured figure of one of the new species, *Cephalodiscus inæquatus*. With his abundant fresh material, the author has reinvestigated the detailed structure of these animals and their systematic affinities. He adopts Willey's name, Branchiotrema, to include all the chordates and invertebrates, and accepts the Pterobranchs as primitive relations of the ancestors of the vertebrate animals.

I. Trägårdh, in a short memoir, describes the Acari, of which he says the Swedish Expedition obtained the most extensive collection yet made in the true Antarctic region. It includes twenty-one species, most of which are new, and one new genus, *Heterogamasus*. Eight of the species were found in the Antarctic; the rest are from the Falklands, South Georgia, and Tierra del Fuego.

The first part of the sixth volume is a memoir by Dr. Strebel on the Gastropods, excluding the naked Opisthobranchs. The collection described is large, but a considerable part of it came from Tierra del Fuego and the Falklands. Sixty-seven new species are founded, including five new genera and two new subgenera, including a new genus of Pteropods, *Thilia*.

Dr. F. Richters, of Frankfort, describes the fauna living in the Antarctic mosses, describing twelve species of Rhizopods and fifteen species of water-bears, of which four are new. He quotes the work of Mr. James Murray, now the naturalist with Lieut. Shackleton's Expedition, who described the tardegrades of the Scottish Antarctic Expedition. Dr. Richters states that there are thirty-eight known species of Antarctic tardigrades, but the knowledge of fifteen of them is so imperfect that only twenty-three can be satisfactorily named.

Dr. Erik Ekelof, of Stockholm, contributes a long account of the bacteriological studies during the expedition, illustrated by a plate showing various cultures. He proves the interesting fact that the Antarctic soils examined are almost free from organic matter. The material which acts as a soil in other countries, and is usually rich in organic constituents, in the Antarctic is composed almost exclusively of purely mineral materials, and is therefore naturally sterile.

The further additions to the biology of the German South Polar Expedition deal mainly with collections formed during the voyage, and are therefore of less special Antarctic importance than those previously issued. Thus Attem's monograph on the Myriopods deals with specimens obtained from the Azores and other Atlantic islands and Cape Colony. Similarly, the main part of Dr. Reichenow's report on the birds consists of a synopsis of the existing knowledge of the sea birds of the world. It is a valuable monograph of the known species, and clearly states their geographical distribution. The second part of his memoir deals with the Antarctic birds; he accepts fifty-three species, of which he describes the characters and distribution.

The two new botanical reports also deal mainly with material collected in the Atlantic region, but they describe in addition various species obtained in the sub-Antarctic regions, at Kerguelen and Crozet islands. Thus Reinbold, in his report on the marine algæ, includes a list of forty-three species from Kerguelen and five from Crozet island, of which, however, none are new. Foslie contributes a short report on the calcareous algæ belonging to the genus *Lithothamnion* and its allies; six species are recorded from Kerguelen, including one new species, which, however, is not described in this report.

The biological contributions now under review contain fewer striking novelties—except the new Pterobranchs—than those described in the former series of reports; but they teach the same general lesson, and, in spite of occasional observations to the contrary, the evidence is against the theory of bipolarity. The reports on several important sections of the biological collections, especially those of the *Gauss*, are, however, still unpublished, and a final verdict is therefore still premature.

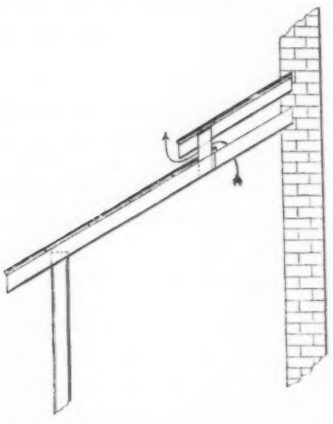
THE OBSERVATION OF AIR TEMPERATURE IN THE TROPICS.

By G. T. McCAW, M.A., F.R.A.S.

During the last few years the question of the accurate determination of the temperature of the air in tropical countries has been forced upon me by a consideration of the methods commonly seen in use in different parts of Africa. My investigations have led to the conviction that in very many cases the problem of the proper protection of thermometers is very imperfectly understood. In the present short paper, I propose to discuss the methods in vogue and the precautions to be adopted.

It is obvious that four conditions must be assured: (1) the instrument must be shielded from the direct rays of the sun, and (2) from the radiation of heat from the ground or adjacent objects; (3) it must be uninfluenced by radiation or convection of heat from any part of the structure erected to carry the thermometer; (4) the bulb must be freely exposed to the circulation of air.

One sometimes sees the instrument hung well in the shelter of the verandah of a house. It may happen that this is satisfactory, or nearly so, but such cases are rare; more often the situation is nearly as bad as it can be; often, again, one may expect very good readings at some hours, and very incorrect measures at others. If the verandah faces east or west, or even in any direction not almost north and south, the readings, especially during the forenoon or afternoon, are certain to be too high in hot weather. The sun beats in on the floor of the stoep and against the wall of the house, and one has often only to stand in such a position to realize that the radiation from the floor and wall (especially the latter) renders the air actually hotter than it feels in the open sun. Moreover, the roof of the verandah is in general constructed without ventilation, so that the hot air is imprisoned just under the roof, in the very spot where the thermometer is placed.



In this connection it may be mentioned that, to ensure the greatest coolness both in the house and on the stoep, the roof of the verandah should be built double, as shown in the sketch. This method is now being adopted in the Sudan, and greatly conduces to comfort.

Again, it is useless to hang a thermometer in a tent pitched in the open sun, even when the tent is double-roofed, and is opened up on all sides. Every traveller soon discovers that the canvas holds and transmits a considerable amount of heat, so that on a hot day one cannot stand up in a tent without feeling the oppression of the warm air which is confined under the apex and comes off the canvas.

A fortiori, it is worse than useless to endeavour to get air temperature by fixing the thermometer under a strip of canvas on a light bamboo or wooden framework

placed in the open. Not only does the sun beat through the canvas, while the canvas itself is a very fair conductor and has considerable capacity for heat, but also the instrument is exposed to the full radiation from the ground. If such an arrangement be employed, it could only be serviceable when the whole is protected by a large wide-spreading tree or similar covering, affording dense shade; but even then the instrument is probably exposed to the direct or indirect rays of the sun in the early morning or late evening. A much better arrangement is a large box, with cover and bottom removed in whole or in part, hung from the tree with its longer sides vertical, and oriented east and west, so as to shut out the direct rays when the sun is low. In this box the thermometer should be suspended freely, and not affixed to the sides.

A pent-house should not be used without closing in the sides facing east and west. If the roof be designed so that its slopes are east and west, and the sides under the eaves be thatched or boarded down to the ground, so that the direct sunlight will not strike the floor, a very fairly satisfactory building for meteorological purposes may thus be obtained. The sides facing north and south are then quite open, and every breeze has free access.

In the tropics, however, there seems no building in general so admirably adapted to the purpose as a properly constructed grass hut. The roof and walls must be *thickly* covered with grass, the framework substantial, and the hut must have high windows or doors fully opened to north and south. In such a hut the instruments are completely shielded from the sun's rays, and there is a large air space with free circulation of air. One precaution is necessary: care must be taken that the instruments may not be broken or records upset in high winds. The objections to the hut are that it requires constant repair, if not annual renewal, and that it is difficult to preclude the possibility of entrance of troublesome visitors. Hence, in many cases the Stevenson screen is preferred.

The Stevenson screen, as commonly constructed in the homeland, is not suitable for countries where there is a high continuous temperature throughout the day. On hot days, when the air is stagnant, or even when the breeze is very gentle or fitful, such a structure becomes a reservoir of heat. If the dimensions of the chamber are greatly enlarged, so as to be about a cubic metre in volume, and if the roof is made double, and the apertures between the lateral ventilators increased in proportion, the objections to the screen will disappear, and the arrangement will probably be the best possible for all stations where it is proposed to keep continuous records. The base of the compartment should not be left open, as is sometimes done, since the instruments are then exposed (except near midday) to the radiation from the soil. Again, other things being equal, the apparatus should be raised above the ground as high as conveniently possible. It will probably be advantageous to orient the structure, so that the doors may face north and south; where no intruders are feared, one or both of these doors, according to the position of the sun, can be left open, thereby increasing the chance of freer movement of the air around the bulbs.

For the traveller in a tropical land where there is no natural shade, it is probable that Regnault's principle of the sling-thermometer can be applied with success; it will assuredly give more accurate determinations of the true air temperature, especially during the hotter hours, than can be obtained with ill-designed portable screens of canvas or wood. A thermometer for this purpose should be enclosed in a stout, solid wooden case, closed at both ends, the bulb being exposed in a hole about ¾ inch in diameter drilled transversely through the case, to permit the free play of air around the bulb. As in all good thermometers, the bulb ought to be elongated, not spherical. The instrument is suspended by a strong cord tied to a ring at the top of

the case. It should be swung in a horizontal plane as high above the ground as practicable, without climbing eminences higher than ant-heaps. Naturally, the reading will be made immediately on the instrument being brought to rest. Some care must be exercised in doing this, as a chuck upwards will cause the mercury to rise in the tube.

In hot countries like the Sahara, where the radiation from the soil is very great, the air may be superheated by the radiation to relatively considerable heights. According to Prof. W. E. Thrift, in such regions the variation of temperature with height would perhaps be considerable, particularly so near the ground. The main effect would probably arise from convection currents, though these might tend towards equalization, but it is not quite obvious whether their effect would be *relatively* greater in hot than in cold countries.

Experiments are wanting to show the results of variation of height. It is advisable, then, that a certain height above the soil, say 6 feet, should be adopted by all observers with a view to uniformity.

A recent experiment* by Prof. R. W. Wood has a very direct bearing on the subject here considered. He finds that the heat in greenhouses is not, as commonly supposed, caused by a lengthening of the heat-waves which impedes their return passage through the glass, but is essentially due to the imprisonment of the mass of heated air. It will thus be seen how important it becomes to construct a chamber which will not in the least interfere with free circulation, for in the normal state in the open the air is in constant motion, and that motion is nowhere greater than in the tropics.

It is hoped that the considerations above advanced may lead to unification of method with a concomitant increase of accuracy, and that these notes may be especially of assistance to those observers who have little leisure for study in the press of administrative duty.

THE SYSTEMATIC DESCRIPTION OF LAND FORMS.†

By Prof. W. M. DAVIS, Harvard University.

One of the most serious tasks of the geographer is the preparation of accurate and intelligible descriptions of the forms of the lands. The earlier method employed in such descriptions was essentially empirical, in that it made no attempt at explanation; its terms, including such words as hill, valley, mountain, plain, river, lake, gave no indication of origin for the features that they named. But in association with these terms were certain others, such as delta, dune, volcano, lava-flow, sea-cliff, which always gave a suggestion of origin. The introduction of terms of the second class was a natural result of the increase of geological knowledge, whereby the existing features of the Earth's surface are more and more clearly seen to result from the action of ordinary processes through long periods of time.

To-day a belief in the reasonable production of land-forms has become so general, that the question may fairly be asked, whether it is not now possible to develop a method of thorough-going explanatory description, which shall treat all land-forms in view of their origin. I have been experimenting on the development

* *Phil. Mag.*, February, 1909.

† Research Department, March 18, 1909.

of such a method for some time,* and believe that it is, in various ways, more useful and more effective than the older-fashioned empirical method, or than the half-hearted, accidentally explanatory method. As at present developed, it may be called the *method of structure, process, and stage.*

Every feature of the land may be treated as the surface form of a certain *structural mass*, accumulated under certain past geological conditions, and placed by crustal movements, with more or less deformation, in a certain attitude with respect to baselevel, so that it comes to be acted upon by various external destructive *processes*, which have now carried forward their changes to a certain *stage* of development. This is only the simplest outline of the method, which may now be illustrated by certain actual examples before proceeding to its complications.

Along the Adriatic coast of Italy, near Ancona (but not including the rocky hills immediately south of this city), the marginal ridges of the Apennines are bordered by a series of imperfectly consolidated sandy and clayey marine strata dipping gently seaward, and originally possessing a smoothly sloping surface, as shown in the background of Fig. 1, which would have deserved the name of

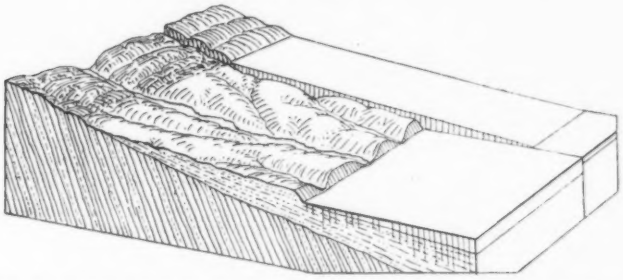


FIG. 1.—BLOCK DIAGRAMS OF A YOUNG AND A MATURELY DISSECTED COASTAL PLAIN.

coastal plain. To-day this simple mass has been elaborately carved by the rivers that were, at the time of the uplift, extended across it from the older land, and by the many smaller streams that had their source on the plain and followed courses consequent on its slope to the sea, as well as by numerous branch streams of more irregular or insequent course; it is therefore no longer a smoothly sloping plain, but a succession of hills and valleys, as in the foreground of Fig. 1. The main valleys of the extended consequent rivers have broad floors, on which the rivers have very gentle fall, and are free to swing from side to side in somewhat irregular meandering fashion; the side valleys are narrower, but everywhere have streamlines of smooth and gentle descent. In the absence of resistant rock layers, which might maintain outcropping ledges, the hillsides are worn back to a gentle slope, and are everywhere cloaked with a slowly creeping sheet of soil. The development of the valleys has been carried so far that hardly a trace now remains of the smoothly sloping initial coastal plain; the sky-line, as seen from any of the higher hills, is gently undulating. During the erosion of the well-opened valleys under the leadership of the consequent and insequent streams, the waves have been at work on the seaward margin of the plain, and have now worn it back so that all the seashore hills are cut off along the shore-line in well-defined sea-cliffs, which

* 'The Geographical Cycle,' *Geogr. Journ.*, 14 (1899), 481–504; also 'Verhandlungen, VII^en Geogr. Kongress, Berlin (1899),' 1901, **2**, 221–251.

stand in a nearly straight line for many miles, although interrupted by numerous valleys. No deltas are to be expected at the mouths of such valleys, because the whole shore-line must be regarded as having retreated.

All of these features are concisely expressed by saying that the Adriatic border of Italy, near Ancona, consists of a coastal plain of imperfectly consolidated sands and clays, which has reached a stage of late mature dissection under the action of normal and marine erosional processes. The term "coastal plain" implies that the strata of which the district consists were laid down as marine deposits, sloping gently away from the land mass from which they were derived; also that they were revealed by a broad uplift which did not significantly disturb their simple structure. The phrase, "imperfectly consolidated sands and clays," gives us to understand that no resistant layers are present which might outcrop in ledges, and thus form falls in the streams or break the even slope of the valley-sides. The brief mention of "normal and marine processes" informs us sufficiently as to the destructive agencies that have been at work on the plain since its uplift. Under "normal processes" we understand the ordinary action of weathering and washing; the streams erode their valleys, and the valley-sides waste under the attack of the weather; the main streams must necessarily be extended forward from their former mouths, and take courses consequent on the slope of the plain to the new shore-line; minor streams must rise on the plain itself, and run down the slope of the plain to the sea; on the sides of the valleys eroded by these consequent members of the drainage system, small branch streams must be established in irregular courses, and these may therefore be called insequent. Under "marine processes," we understand the action of sea-waves and currents, which actively attack the shore, cutting it back in a cliff; at the same time they slowly wear the bottom, gradually giving it an increasing depth. The significant words, "late mature dissection," indicate at once that both of the erosional processes, normal and marine, are well advanced in the series of changes which have, as a goal, the complete destruction of the coastal plain. The main streams must in late maturity have opened wide-floored valleys; the side streams must branch elaborately, thus dissecting the original plain into a multitude of hills and spurs; the axes of the hills and spurs must trend in a general way toward the coast, because the streams which have carved the valleys between the hills must for the most part have had their courses determined, directly or indirectly, by the initial slope of the plain; the hills must have been weathered into smoothly arching crests and smoothly sloping sides; the shore-line must have been cut back so as to truncate the hills in cliffs, all standing in line. Thus a general mental image of the district may be formed, in which all the features are systematically correlated, because they are all described as having originated by the action of definite processes on a comprehensible initial form, and because the action of the processes has gone on to an assigned stage of development.

Two features, shown on a larger scale in Fig. 2, remain to be described. The broad, late mature, main valley-floors are not flat, but are found to be moderately terraced as one advances inland; and the shore-line does not now lie along the base of the mature cliffs, but along the outer side of a sandy strand-plain, 100 or 200 metres wide. The terraces are evidently the result of a recent and gentle slanting uplift, after the valleys had been maturely widened; and judging by the height of the terraces, the uplift seems to have increased from zero near the coast-line to 10 or 15 metres at the inner border of the plain. Perhaps half or more of the former valley-floors has been consumed in the excavation of the newer and lower valley-floors, so that the present flood-plains in the main valleys are of somewhat greater area than the terrace remnants of the former flood-plain. The strand-plain is evidently the result of a recent change in the action of the shore-waves. From having acted

as erosive agents for a time long enough to cut the mature cliffs, they have for a briefer time acted as constructive agents, and have built forward a low and narrow belt of sand; in other words, after having maturely retrograded the cliffs, the waves have prograded the strand-plain. The strand-plain broadens a little opposite each valley, for now that the shore-line is prograding, the rivers have opportunity of building their deposits forward; but no sharp deltas are seen, because the long-shore action of the waves and currents distributes the river-brought waste all along the front of the strand-plain.

There is good reason for regarding the action of the streams in terracing or degrading the former valley-floors as the cause of the progradation of the strand-plain. The slanting uplift revived the mature streams, and caused them to degrade the valleys through which they were previously flowing contentedly; the degradation of the valley-floors increased the quantity of waste washed out from the river-mouths, and thus compelled the waves to abandon their former task of cliff cutting

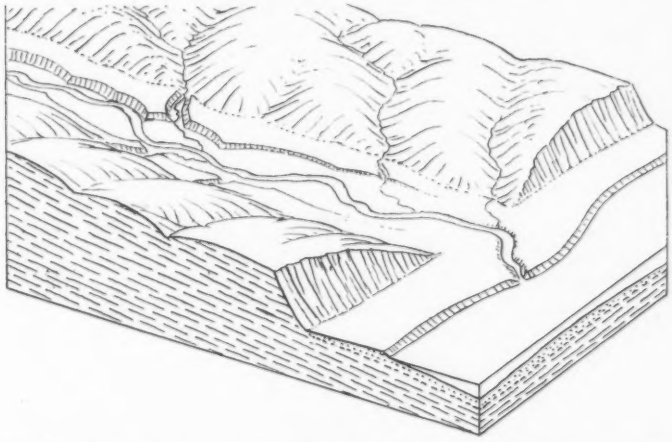


FIG. 2.—BLOCK DIAGRAM OF A COASTAL PLAIN WITH A TERRACED VALLEY AND A STRAND PLAIN.

or retrograding, and for a time at least to take up the contrary task of distributing the river-waste along the shore, thereby building forward or prograding the strand-plain. The previous description may therefore now be expanded and supplemented as follows:—the coastal plain of imperfectly consolidated sand and clay strata had reached a stage of late maturity by normal and marine erosion, when a gentle slanting uplift occurred, which caused the extended consequent streams to terrace the main valley-floors, and the waves and currents to prograde the shore-line. If any doubt is felt on the correlation of these features, it may be indicated by the cautious words, *as if*. After the coastal plain had been dissected to a stage of late maturity, its broad valley-floors were gently terraced, and its shore-line was prograded, *as if* a gentle tilting uplift and revival of stream erosion had taken place. When this stage of general description is reached, individual elements, such as length, breadth, and height, may be added, and villages and lines of travel may be appropriately located. If such details are introduced before the general features are sufficiently presented, they are lost in a confusion of half-understood forms.

Certain general considerations may now be mentioned. First, it may be pointed out that only so much of past history, or what may be properly called geology, is introduced as will be of direct service in reaching an understanding of present form. Other geological information, however important and interesting in itself, is irrelevant, and should be omitted. Second, the slight complication caused by uplift, after late maturity of dissection had been reached, is significant, for it illustrates what often happens, namely, the occurrence of a movement of the land-mass during the progress of its sculpture, whereby the cycle of erosion, until then current, is interrupted and a new cycle is introduced. "Interruption" of a cycle may therefore always be used in a somewhat technical sense to indicate a crustal movement whereby the land-mass has been placed in a new attitude with respect to baselevel. In the case of the Italian coastal plain, the interruption was a slight one, causing hardly more than an episode in the former cycle instead of introducing a new one. In the following case a more serious interruption is considered.

Eastern Virginia and Maryland, typified in Fig. 3, contain a maturely dissected coastal plain, recently somewhat depressed. The new cycle thus introduced has not passed beyond early youth. A useful picture of the essential features of the

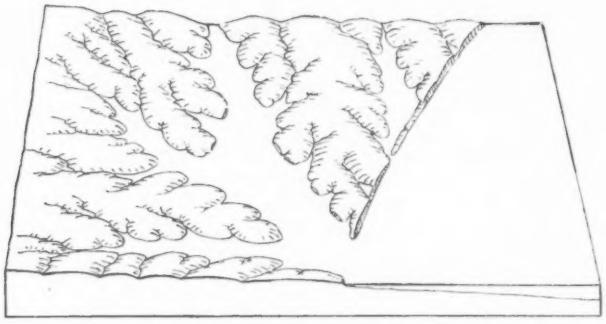


FIG. 3.—BLOCK DIAGRAM OF A MATURELY DISSECTED COASTAL PLAIN, RECENTLY HALF SUBMERGED.

district concerned may be constructed from this brief explanatory description. The structure of the district will be understood from the term coastal plain, which means, as already stated, that the area is made up of stratified deposits sloping very gently toward the ocean from an older land of other structure in the background. The chief features of surface form may be inferred from the phrase, maturely dissected; for this implies, as before, the presence of main and subordinate consequent streams, with many insequent branches, and of well-opened valleys, with sides that slope gently down from rounded hill-tops. When this stage in the cycle was reached, its further normal progress was interrupted by a movement of depression, thus placing the mass in a new attitude with respect to baselevel, and introducing a new cycle of erosion. The maturely dissected coastal plain having been somewhat lowered, its main valleys and many branch valleys are necessarily partly submerged, and converted into long irregular branching bays of very sinuous shore-line; and the new shore-line thus produced is as yet but little modified by wave cutting and delta filling, the modification being more along the outer coast and at the chief bay-heads, where the ocean waves and the larger rivers are at work, and less in the bays where only the weaker waves and the

smaller streams are in action. The effective picture thus sketched may now receive as many additional touches as are desired in the way of length, breadth, height, and individual features. Various complications in the history of the district, concerning which discussion is still going on, are not here referred to.

It must be manifest from the two foregoing examples that the method under consideration involves a scheme of description and not a plan of investigation. The chief events in the geological history of a district, in so far as they bear on its form, must be found out before the method of explanatory description can be applied. Nevertheless, the method is helpful in investigation, first by indicating the kind of results that must be searched for, and second by indicating the kind of results that are irrelevant in the geographical sense, and therefore better omitted than included in a geographical description. One who is familiar with recent articles on the geomorphological aspects of physical geography must have noticed that the attention of the reader is often distracted from features of present form by the introduction of unessential matters of past history, with the result of making the description geological rather than geographical. If the intention of the writer is to give an account of past changes in their chronological sequence, it is proper enough to focus the attention on the passage of past time; but if the intention is to give an explanatory description of existing forms, it is important not only to exclude all matter that has not a helpful relation to existing forms, but to present the explanation of existing forms in such a way as to direct attention to them as the present product of past processes, not to the processes themselves; and in this respect the systematic method here presented may be of much practical assistance.

It is also clear that the systematic method is not completely self explanatory; it involves a special terminology of which an understanding must be gained before the method can be serviceable. For example, the phrase, "maturely dissected," can be properly appreciated only after the general scheme of the cycle of erosion has become familiar; but as the scheme of the cycle of erosion has now been before the geographical public for at least ten years, it is not necessary to regard it as a novelty any longer. Again, the effect of submergence in transforming valleys into bays must be recognized before the phrase, "recently somewhat depressed," can gain its full value; but the idea here involved is so simple that the wonder is that geography had to wait until the latter half of the nineteenth century for its introduction.

A third example may be taken from the western slope of the central massif of France, in the neighbourhood of the valley of the Lot. This district, of which a diagram is given in Fig. 4, may be described as a maturely dissected plateau of indurated horizontal strata, in which the valleys of the smaller consequent and insequent streams show the work of only one cycle, while the main valley of the Lot shows the work of two, in the first of which the late-mature meandering river had nearly consumed its valley-side spurs; and in the second, introduced by a moderate uplift, the river has now consumed about half of the previous flood-plain in reaching maturity again. The mental picture of the district, constructed from this description, must embody a great number of rounded hills of equable height, divided by many irregularly branching valleys; for in a plateau of horizontal strata, most of the drainage must be insequent, without systematic control, and hence following no definite direction. The hillside slopes, smoothly covered with creeping waste, must descend with gracefully curved profiles to the narrow valley-floors of the well-graded smaller streams. But the main valley of the Lot must be conceived as broadly opened and as showing a well-defined, gravel-covered terrace (horizontal lines, Fig. 4), below which the curving river has eroded a narrower valley, with well-developed and systematically placed flood-plain scrolls (dotted, Fig. 4). Rock outcrops are to be expected only along the outer side of the river curves, where the

valley-side amphitheaters are being enlarged, and along the down-valley side of the curves, where the up-valley side of the terrace-spurs (not seen in Fig. 4) is being worn away. The reason for the visibility of the work of two cycles in the main valley is evidently that the main river works rapidly; it had developed a late-mature or broad-floored valley in the first cycle, when the branch streams had

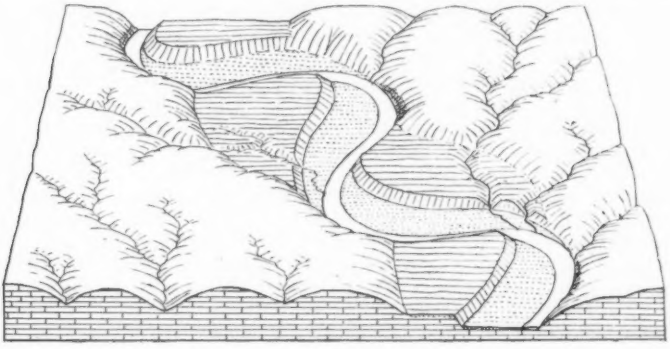


FIG. 4.—BLOCK DIAGRAM OF THE TERRACED VALLEY OF THE LOT IN WEST-CENTRAL FRANCE.

eroded only early mature or narrow-floored valleys; now in the second cycle, the branch streams have deepened their valleys and have become mature enough to destroy practically all traces of the former floors; while the main stream, although already more mature than the side streams, has not yet widened its new valley-floor sufficiently to consume all of its still broader, earlier valley-floor.

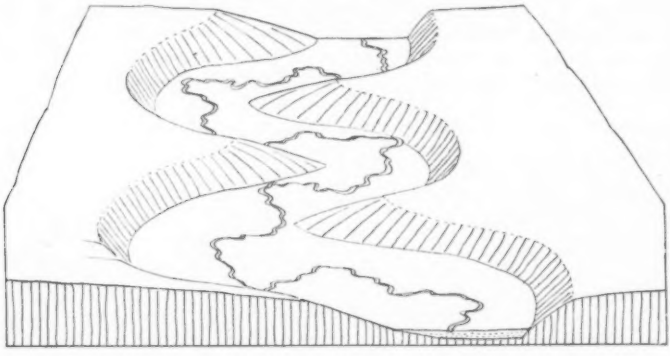


FIG. 5.—BLOCK DIAGRAM OF A MEANDERING VALLEY WITH SHARPENED SPURS, OCCUPIED BY AN UNDERFIT STREAM.

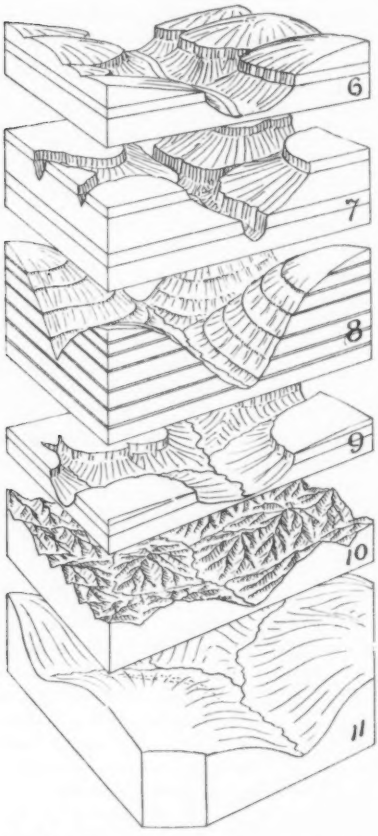
An interesting variant on Fig. 4 is given in Fig. 5, in which the curves of the valley-sides between the sharpened spurs indicate that the valley was given essentially its present form by a river of good size, whose curves were of the same dimensions as those of the valley-sides, as is the case in Fig. 4; yet at present the slender stream by which the valley is drained wanders about most irregularly on the valley

floor in curves of much smaller pattern. Such an abnormal relation between valley and stream often occurs; it may be concisely presented by first describing, in terms of flood-plain breadth, curve radius, and spur-trimming, the stage of development reached by the valley, and then describing the stream that drains it, in terms of breadth and curve radius. It seems clear in such a case that the original valley-cutting stream must have been much reduced in volume. In its present reduced volume it may be described as a misfit or an underfit stream.

It is manifest that the features summarized in Figs. 4 and 5 can be, as before, best appreciated if the observer or the reader has already made a systematic study of an entire series of appropriate ideal forms, developed in regular order. In the case of a plateau, for example, certain naturally associated forms characterize the youthful stages of its dissection; other forms, the mature stages; still other forms, the old stages. It will evidently be of much practical benefit to an observer who has to describe plateau forms, if he has previously gained familiarity with the whole series of changes through which a plateau passes in the course of a normal cycle of erosion; he may then most concisely describe an actual case as corresponding to a particular member of the series of ideal cases; and all his readers, who are familiar with the same scheme, will immediately apprehend his meaning. In this respect, the scheme of description here recommended is practically serviceable because it greatly increases the number of ideal forms with which the observer is equipped, and in terms of which the actual forms that he finds may be described. The ideal forms are, moreover, easily apprehended and remembered, because all their parts are reasonably developed and associated. In the same way, the beautiful series of ideal forms developed during the erosion of a valley by a meandering river must be studied out, and the terms used in their description must be known, before the use of the terms in a description can summon up the desired forms. Actual forms of this kind frequently occur; it is therefore fitting that an effective terminology for their description should be introduced; and the most effective terminology yet suggested is based on the sequence of valley forms that is systematically developed during the progress of an undisturbed cycle of erosion.

Another advantage of the explanatory method is the ease with which a simple series of ideal forms, such as those of the plateau series above mentioned, may be expanded into a more elaborate series, so as to fit a much larger variety of natural cases. In the first place, a plateau mass of horizontal structure may be conceived as consisting of resistant and weak strata in any order; a group of resistant strata between two groups of weak strata, as in Fig. 6; or a group of weak strata between two groups of resistant strata, as in Fig. 7; or many alternations of resistant and weak strata, as in Fig. 8; and so on. The general plan of development being once understood, all the particular features that will be associated with each particular structure may be easily deduced. In the second place, a plateau of any special structure may, at the beginning of its cycle of erosion, stand high or low; the relief developed by its dissection will evidently be strong during the youth and maturity of the first case, as in Fig. 8, but can never be strong in the second case, as in Fig. 9. Finally, the texture of dissection—that is, the spacing of the streams and their valleys, and the resultant breadth of the hills and spurs—may vary according to certain conditions, the chief of which are the perviousness of the plateau mass, or at least of its soil cover, and the climate under which its dissection takes place. Pervious strata allow much of the rainfall to enter the ground and thus diminish the number of small branch streams; as a result, the texture of dissection is coarse, and the hills are broad and full bodied, as in Fig. 11. If the strata are impervious and of fine-grained materials, and if the climate is so dry as to make vegetation scanty, then the texture of dissection during youth and early maturity will be very fine, and the

surface will assume a "bad-land" quality, with innumerable little hills and spurs between innumerable little valleys, as in Fig. 10. Thus the scheme of description really contains five elements: structure, process, stage, relief, and texture; all require consideration, but the first three suffice when giving the scheme a name.



FIGS. 6 TO 11.—BLOCK DIAGRAMS OF DISSECTED PLATEAUS VARYING IN STRUCTURE, RELIEF, AND TEXTURE OF DISSECTION.

The diagrams which accompany the descriptions thus far presented serve a certain purpose in providing an easy means of establishing types of ideal forms. They are rough, and yet they carry about as many details as verbal description can profitably undertake to repeat. The few diagrams here offered may be supplemented by many others, illustrating earlier and later stages of development, in the case of coastal plains; diverse structures, varying from horizontal to inclined, faulted, folded, massive, and so on; varied combinations of resistant and weak strata, as well as different measures of relief, in the case of plateaus; differences in the scale of texture, from coarse to fine, and so on. It is manifest that the observer who is equipped, mentally or graphically, with a large number of type forms, correctly deduced and systematically arranged and developed, will be greatly aided when he comes to describe actual forms, and that the reader who has a corresponding equipment will be able to appreciate very closely the meaning of the observer. We may now pass to a fourth example.

Snowdon and its neighbours in North Wales, summarized in Fig. 12, consisting of greatly deformed and resistant strata, have been recently submaturely glaciated, after having been normally reduced to subdued forms. Let us analyze and expand this brief statement. As the deformed strata of the mountain group are all resistant, we must not expect any well-developed ridges trending along the strike of hard strata, or valleys eroded along the strike of weak strata, but a group of mountains and spurs irregularly divided by prevailingly insequent valleys. As the mountains are described as having been normally subdued (or developed to late maturity), previous to glaciation, we must imagine them as having lost the great height and sharp peaks and ridges that may have prevailed in the younger stages of their cycle

of normal erosion, and as having been reduced to dome-like masses, with rounded ridges and spurs sprawling irregularly between well-opened valleys; outcropping ledges must have been rare or wanting, because subdued mountains must always be pictured as very generally covered with a creeping sheet of rock-waste; lakes and waterfalls must have been absent, because such features are destroyed by the late mature development of the streams and valleys; and all the side valleys must be thought of as joining the main valleys at accordant grade, because even if discordant or hanging valley junctions had occurred in an early stage of the normal cycle, accordant valley junctions must necessarily have been developed by the time the mountains between the valleys had been subdued.

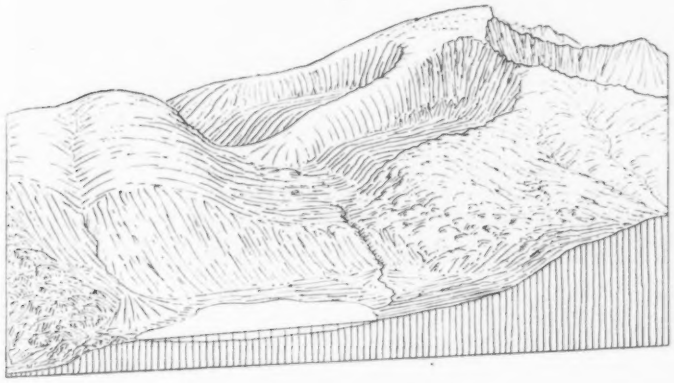


FIG. 12.—DIAGRAM OF SNOWDON, NORTH WALES.

The mountain group thus fashioned then suffered submature glaciation, and this necessarily introduces many changes. All the normal valley heads will be enlarged and converted into cwms; the cwm-head cliffs will, in a submature stage of glaciation, be retrogressively eroded so far into opposite sides of the subdued mountain domes as to consume parts of the intervening rounded mass, and to convert them into sharply serrated arêtes; the cwm-floors may be so well deepened as to hold small rock-basin lakes; the broadened floor of the cwms, as well as of the smaller lateral valleys, will descend by a strong slope into the larger valleys, which have been deepened and broadened as glacier troughs; thus the cwms as well as the side valleys will come to stand over, or to "hang," with respect to the deepened main valleys (or glacial troughs); and the deepened main valley-floors, being only in a submature stage, may exhibit various inequalities, here scoured out a little deeper so as to hold a lake; there unevenly worn down so that a rock-step interrupts the valley slope; and again showing immature lateral scouring, so that knolls, ledges, and cliffs are locally abundant along the valley-sides. Finally, as the submature glaciation is described as recent, the changes since a normal climate has been re-established must be small; the cwm-head cliffs will have weathered somewhat, so that slopes of waste (screes) accumulate at their base; the cwm-floor basins may be partly converted into bogs; the front steps of the cwms and of the hanging lateral valleys may be somewhat cleft by normal stream action; deltas will be growing in the valley-floor lakes, gorges will be partly eroded in the rock-steps, and slopes of waste will be forming under the valley-side cliffs. But as the glaciation

is explicitly described as submature, we must imagine smaller parts of the higher domes and larger parts of the lower domes to retain their preglacial subdued forms, with only so much change as may have been caused by general weathering during the glacial period.

When all these significant features have been conceived, we may add that

FIG. 13.—NERVI ON THE MARINE PLATFORM OF THE RIVIERA LEVANTE, LOOKING NORTH-WEST.

FIG. 14.—THE VILLAGE OF SESTRI LEVANTE, ON THE ISTHMUS OF A LAND-TIED ISLAND: THE PENINSULA OF PORTOFINO IN THE DISTANCE, LOOKING NORTH-WEST.

Snowdon, the highest dome of the group, has been so greatly reduced by the excavation of four large and two smaller cwms in its flanks as to present only a skeleton of its former self; that its north-eastern, south-eastern, and south-western rounded ridges have been narrowed into sharp arêtes; that its eastern cwm holds lakes at two levels, separated by a rock-step; that Mynydd Mawr, a fine dome but of less altitude than Snowdon, has two cwms of so moderate a size as to leave a

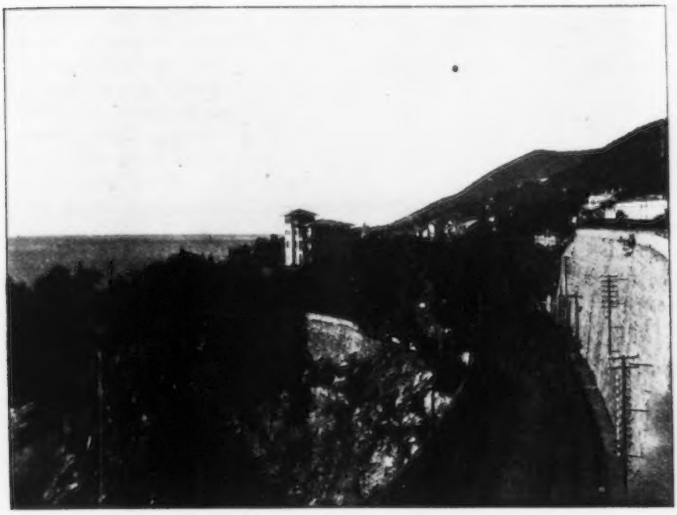


FIG. 15.—ENCROACHMENT OF A WAVE-CUT COVE ON THE NARROWED MARINE PLATFORM BETWEEN BOGLIASCO AND SORI, LOOKING NORTH-WEST.

FIG. 16.—THE RAILWAY STATION AT ZOAGLI, BETWEEN TUNNELS IN CLIFFED PROMONTORIES, LOOKING SOUTH-EAST.

great part of its dome intact; but that its southern and north-eastern sides have been cliffed by the strong over-deepening and widening of the neighbouring valleys; that several good-sized, unconsumed rock-knobs obstruct an otherwise well-excavated trough on the south-east (valley of Afon Glaslyn), between the valley-floor rock-basins of two lakes (Gwynant and Dinas); that an uneven, low rock-step occurs in the chief trough on the south-west (valley of Afon Gwarfai) not far below a rock-basin lake (Cwellyn), which, like the other basins, shows some delta-filling at its upper end; that the fine hanging lateral valley, which heads in the great cwm (Clogwyn) in the west face of Snowdon, has a small gorge cut in the slope where it opens in the side of the deeper main trough (Afon Gwarfai valley); and so on.

It is true that geographers and geologists are not yet agreed on the problem of glacial erosion, and it would therefore be prudent to precede the whole of the foregoing explanatory description with the statement that the writer finds the evidence in favour of glacial erosion irresistible; and, further, that he finds it possible to work out a series of ideal forms due to glacial erosion much in the same way that the series of ideal forms due to ordinary erosion has been worked out—that is, by a legitimate and logical combination of induction and deduction. It is then just as serviceable to describe the actual forms of a glaciated district in terms of the ideal forms of a cycle of glacial erosion, as to describe the actual forms of a normally eroded district in terms of the ideal forms of a normal cycle; or as to describe the actual forms of a coastal district in terms of the ideal forms of a marine cycle. The verity of glacial erosion is now so well established by the study of the forms of glaciated mountains in many parts of the world that it savours of undue conservatism to omit such forms from the systematic method of description that has proved so helpful for other forms.

The foregoing description of the Snowdon group involves a departure from the normal cycle unlike the interruptions caused by crustal movement, which occurred in the case of the two coastal plains already considered. The departure from normal conditions in the case of Snowdon does not appear to have involved any significant change in the altitude of the land, but only a temporary change in climate, whereby the snowfall was increased and glaciers were formed where none existed before or since. Such changes may be treated as accidents which disturb the regular progress of normal processes. It is important to point out that the duration of the glacial period in Wales, as measured by the work then accomplished, must have been a very small fraction of the duration of a normal cycle of erosion. The glacial accident was therefore a brief one; the normal cycle is now again in progress.

It was stated in an early paragraph that land forms, treated as the surface of rock masses, may be described in terms of structure, process, and stage. It must now be added that the description of land forms, thus considered, must always be associated with two other elements: one of these is the active process, which works on the land form and causes its change; the other is the land waste produced by the action of the destructive process on the passive structural mass. In a cycle of normal erosion, we have weather and streams as elements of the active process; and locally weathered soil, sheets of creeping soil, alluvial fans, flood-plains, deltas, and so on, as elements of the forms assumed by the waste of the land on the way to the sea. In a cycle of glacial erosion we have weather, snow-fields, and glaciers as elements of the active process; and locally weathered superglacial rock waste, moraines of various kinds, drumlins, eskers, kames, and so on, as the forms assumed by the waste of the land in association with glacial erosion. In a cycle of marine erosion we have weather, waves, and currents acting on the coast; and beaches, sand-reefs, tidal marshes, and so on, as the associated waste forms. In a cycle of

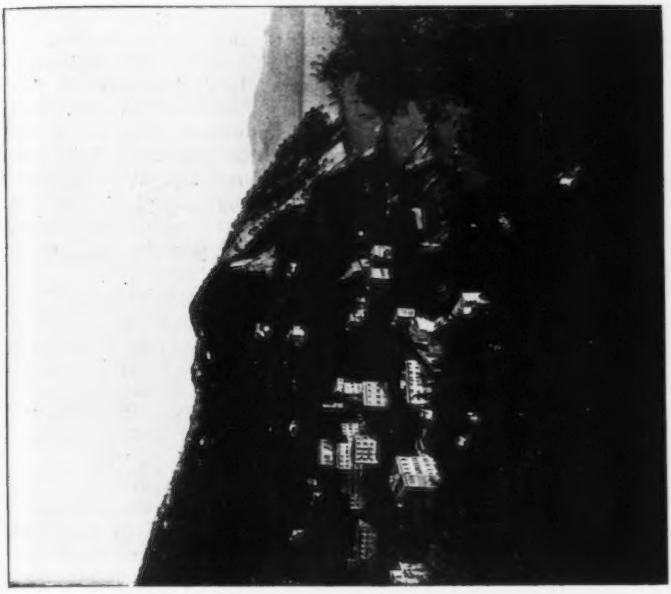


FIG. 18.—ZOAGLI AND THE NEW-CUT SEA-CLIFFS, LOOKING SOUTH-EAST.

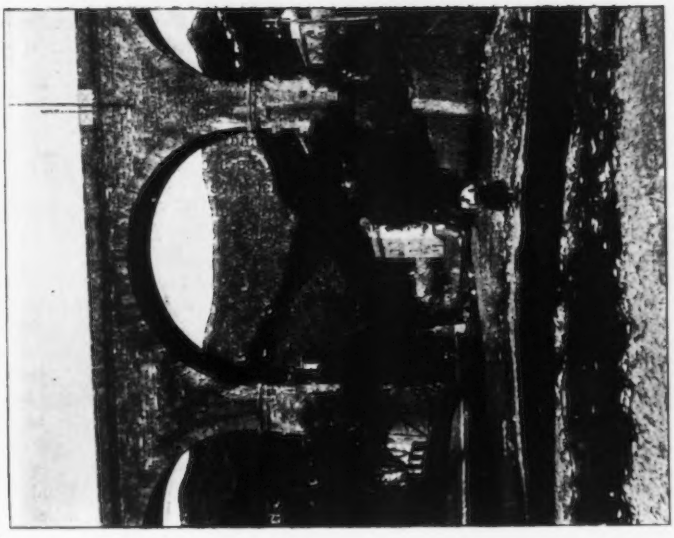


FIG. 17.—RAILWAY VIADUCT OVER VALLEY MOUTH AT BOGLIASCO, LOOKING NORTH-EAST.

solvent erosion, such as prevails in limestone regions, travertine deposits gain an importance among waste forms, even to the point of building up barriers across valleys and causing lakes and waterfalls, such as occur in Karst districts. The falls of Tivoli, near Rome, are of this origin. In the cycle of arid erosion, sand-dunes and loess deposits become of importance. In all these cases, the forms assumed by land waste vary systematically through the course of the cycle. In the normal cycle, for example, coarse rocky waste is usually associated with a young stage of the cycle, when valley-sides are steep; while fine waste prevails in the late stages, when the relief is faint and the slopes are gentle. A whole series of interesting considerations follow naturally upon the systematic description of the forms assumed by the waste of the land on the way to the sea, in association with the land forms on which the waste lies and with the processes that are acting upon it.

A final example may be taken from the *Riviera levante*, the mountainous Italian coast between Genoa and Spezia, illustrated in Figs. 13–22. We have here, as on the Adriatic coast, a combination of normal and marine erosion, and a slight movement after maturity was reached; but the results are quite unlike those already described, because of certain differences that accompany the similarities. The district includes a part of the Apennines, in which the strata, chiefly sandstones of fairly uniform resistance, are greatly deformed. It is highly probable that more than one cycle of normal erosion has taken place since the strata were deformed; but we are first chiefly concerned with the last cycle but one, during which the mountains were very generally reduced by normal erosion to subdued forms, except where masses of resistant intrusive rocks occur, while a late mature sea-cliff was cut back along the shore-line. Then an interruption occurred: a very gentle tilting took place on an axis at right angles to the shore, producing a slight elevation to the northwest and a corresponding depression to the south-east; and the new cycle thus introduced has as yet reached only an early or submature stage. Now, as in the previous examples, this concise description may be expanded and explained.

The mountains along the coast must, when the first cycle was interrupted, have generally presented rounded forms, cloaked with creeping waste, and dissected by irregular or insequent valleys of advanced development; the coastal cliffs must have evenly truncated all the spurs that approached the sea; as the cliffs are described as late mature, they must have gained a considerable height by being cut far back into the mountains; but at the same time they must have lost their youthful steepness, because the waste that would be shed from a high and steep cliff could not be disposed of by the waves that must have been weakened by rolling in to the shore across a broad and shallow platform of marine erosion; the streams had no deltas of significant size, because the whole shore-line was in retreat or retrogression.

Now the gentle tilting takes place. To the south-east the sea beats above the cliff-base and invades the valley mouths; at a score of miles from the axis of tilting the depression suffices to submerge a low col, and convert an outlying ridge-end into an island. In the other direction, the marine platform, covered with a thin sheet of sea-laid waste, is revealed as a young coastal plain of increasing height and width to the north-west. The processes of normal and marine erosion then again proceed in their work upon the land mass in its new attitude, but as yet they have made only moderate progress.

Where the sea now beats on the face of the somewhat submerged cliffs, it steepens them, and makes the shore-line more ragged than before, disclosing disordered rock structures; where the valley mouths have been drowned into bays, deltas are filling the bays and converting them into small triangular, beach-fronted, seaside

FIG. 19.—THE CHURCH AND CASTLE OF CAMOGLI, ON A ROCK-REMNANT OF THE CONSUMED MARINE PLATFORM, LOOKING NORTH.

FIG. 20.—THE VILLAGE OF CAMOGLI, CROWDED TO THE WATER'S EDGE.

plains. Naturally enough, the largest river of the region, about ten miles south-east of the axis of tilting, had eroded the widest valley before the tilting took place; the slight submergence of this wide valley made the largest bay; but the large river has now aggraded the bay, forming the largest plain, along the front of which the waves break evenly on the longest beach of the district: and here stands Chiavari, the largest town between Genoa and Spezia. The delta-plain is indeed built forward somewhat outside of the bay-mouth, so that it now stretches right and left, a mile or so, in front of the steepened cliffs. The island a few miles further south-east is now cliffed on its outer side, and tied to the mainland by a beach from its inner side, so as to form a peninsula. Farther south-east, there are only small delta-plains between great steepened cliffs, to the point that encloses the Gulf of Spezia. The railroad along this stretch of the coast runs through tunnels back of the cliffs for a large part of the way, coming out to breathe as it crosses the small delta-plains.

In the other direction, towards Genoa, the extended rivers have cut mature valleys across the marine platform and its gravel beds, and have therefore somewhat deepened their former valleys among the mountains, with the result of frequently making the mountain-sides steepest near the stream line; at the same time the former sea-cliff has become less steep by the creep of waste from its upper part to accumulate at its base; and the sea has cut away the outer part of the platform, so that its present border is a ragged, immature, beachless, harbourless cliff of moderate height. Near the axis of tilting, where the plain was necessarily low and narrow, it has been entirely consumed, and here the sea is now renewing its attack on the former cliff, undercutting it somewhat below the former base. Farther from the axis, where the coastal plain was broader and higher, a larger and larger share of it remains, so that villages are built on it; still farther north-west, the remnant of the plain is a mile or more wide, and its ragged cliffs are 300 or 400 feet high; nearly all of this height is cut in rock, beneath the level of the gravels of the former sea-bottom; here Genoa lies, partly on the plain, partly in the mature valleys that have been cut across it.

At the axis of tilting stands the peninsula of Portofino. It is protected by a heavy conglomerate along its exposed front, and was therefore not worn back by the sea to the general cliff line in the first cycle. The delta-plains on the south-eastern side of the peninsula give open space for the towns of Rapallo and Santa Margherita. No deltas are found on its north-western side; and there the town of Recco is crowded to the shore-line at a valley mouth close to the new cut cliffs. The superb view from the summit of the peninsula includes nearly all the features here mentioned, but to appreciate the details of this marvellous coast, one must stop at successive stations and walk from village to village. The railway ride is tantalizing, because one hardly has time to enjoy a charming view before the train enters a cut or a tunnel. A few miles out from Genoa one may turn from the main road, up the narrow paths through terraced flower gardens to the olive groves, whence the openings disclose extensive vistas over the marine platform where Nervi is built upon it (Fig. 13), between the long sloping ascent of the former sea cliff and the sharply undercut margin of the present coast. Here the railroad runs on the platform in shallow cuts, crossing the new valleys on high viaducts, as at Bogliasco (Fig. 17); but as the platform is narrowed by sea encroachment, some of the shore coves threaten to undermine the track, as between Bogliasco and Sori (Fig. 15). A little farther toward the axis of tilting, as between Sori and Recco, the platform is all consumed, and the new cliff undercuts the old one (Fig. 21); here the highway mounts the slope and the railway tunnels. In strong contrast to Nervi and Bogliasco, which find room for gardens about their villas, is Camogli, on the north-western side of

FIG. 21.—THE NEW SEA-CLIFF UNDERCUTTING THE OLD ONE, BETWEEN SORI AND RECCO; THE UNCONSUMED MARINE PLATFORM BY NERVI IN THE DISTANCE; LOOKING NORTH-WEST.

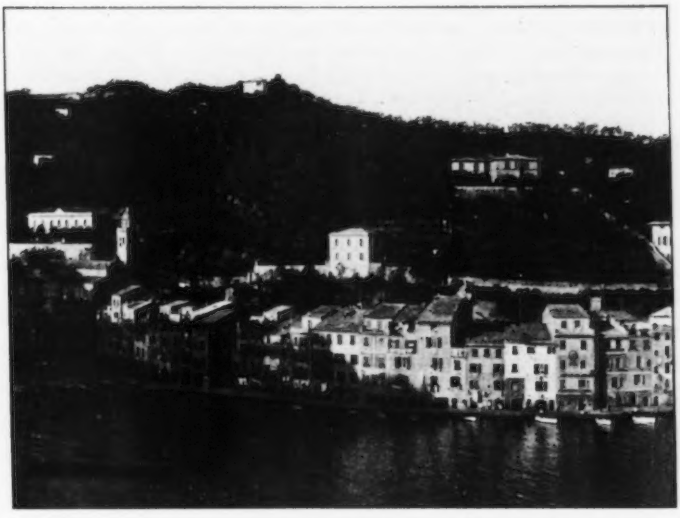


FIG. 22.—THE VILLAGE OF PORTOFINO, IN A BAY AT THE SOUTHERN CORNER OF THE PORTOFINO PENINSULA, LOOKING NORTH.

the Portofino peninsula; here the hills descend directly to the sea, and the tall houses are built up from the beach (Figs. 19 and 20); for the platform of farther north-west and the delta-plains of farther south-east are both lacking, and the village site is therefore necessarily on the steep hillside at a deepened valley mouth.

After the axis of tilting is past we find the little village of Portofino (Fig. 22) built around a small bay in a corner of the peninsula, where the tributary valley is so small that the bay in not yet converted into a delta-plain. Farther on, the former cliffs are sharply undercut at the new sea-level (Fig. 18); here the highway must ascend to a considerable height above the shore-line in passing around the promontories, while the railway tunnels at a lower level (Fig. 16). Then comes the broad delta-plain of Chiavari, and next is the picturesque town of Sestri Levante on its isthmus (Fig. 14). Still farther on is Moneglia, where the new cut cliff at the end of a spur between two small valleys is now protected by the forward growth of the two confluent deltas; and finally comes Porto Venere, where this littoral range of the Apennines dips under water and ends. The whole district is a delightful field for geographical exercise and enjoyment.

The chief object of this essay is to persuade English geographers to look into what is here called the method of structure, process, and stage, and make trial of it in the description of land forms. The trial can be made in two ways: the observer himself may describe a given district by two methods, one being the method here recommended, the other being any other method—the empirical, for example—and he may then himself compare his descriptions as to lucidity and compactness. A more thorough test will be made if the two descriptions are submitted to two competent readers, each of whom reads only one description and then proceeds to draw a map or diagram of the forms described, the maps afterwards to be compared as to expressiveness; it is desirable that no local names should be used in this test, so that the readers shall not know anything of the place described except what is contained in the descriptions. A still better experiment may be made by selecting a standard empirical description of a district known to the experimenter, writing an explanatory description of it in the same number of words, and comparing the lucidity of the two accounts.

Before the paper, Dr. STRAHAN: You will all, I am sure, agree with me that the Department is to be congratulated on having this opportunity of hearing one of the greatest masters in the art of expounding geographical problems. The opportunity has arisen through Prof. Davis being now on his way home from Berlin after an exchange of professorial duties with Prof. Penck, an interchange which constitutes the most graceful compliment that could be paid by the universities of one country to those of another. I will not detain you, but will at once ask Prof. Davis to give us his paper.

After the paper, Dr. STRAHAN: I think I may call upon you, in the first place, to testify to your appreciation of the extremely clear illustration of land-forms and their origin which we have had placed before us this afternoon. I have great sympathy with Prof. Davis in his claim that the nomenclature should be, to a certain extent, self-explanatory. Such a nomenclature, used as it was by himself, appeared to me to be admirable, and to enable him to put, in a few precise words, matter which a less skilled lecturer would have used many sentences to express. Numerous different problems of erosion have been touched upon this afternoon, the consideration of which is likely to lead to an interesting discussion. I hope it will not be necessary to impose any limit, and trust to the good sense of the speakers to remember that there are others to follow them. I now invite discussion.

Sir JOHN MURRAY: I do not think I am quite in a position to open the

discussion, because I can hardly say I am a complete master of Prof. Davis's nomenclature; but he has done so much within the last twenty years to render our nomenclature of earth-forms more definite, that I think we are very much indebted to him for coming here to-day and personally explaining some of his views. It would take him, as he says, a whole session to lay the complete scheme before us. As he indicates, this is not a method of investigation. It is a nomenclature to explain existing forms. Now, it seems to me a sort of selection from the geologists with new explanatory names. I rather look on these things more from the geological point of view than the geographical, and Prof. Davis has selected, I should say, from geological knowledge a very large amount of data, and has summarized them so that they can be available for the geographer. I am not sure that geologists, on the whole, are so very enthusiastic about his nomenclature as the geographers are. When this nomenclature is applied to the description of a river-valley, for example, showing its youth, maturity, and old-age conditions, it seems to me very interesting and instructive. It conveys a lot of information that is quite explanatory. The whole tendency is to use more and more explanatory terms in geographical descriptions.

The subjects which Prof. Davis has laid before us to-day deal more with the minor features of the Earth's surface as related to geology. But there are larger features which have to do probably more with meteorology than geology. The most striking features might be said to be regions of *internal drainage* on the continents—where there is a rainfall of less than 10 inches in the year, where desert conditions prevail, where the rivers never reach the sea, where salt lakes exist, and where denudation and disintegration of the rocks show great peculiarities. These regions, which exist in two bands around the Earth north and south of the equator, have a great effect on all human phenomena, and may be contrasted with those regions where a greater rainfall exists and rivers all pour their waters direct into the ocean. I mention these regions merely to show that earth-forms may be looked on from many points of view. It cannot be denied that by directing the attention to earth-forms and their geological origin, Prof. Davis has greatly advanced the study of geography, and we may offer him our congratulations.

Prof. Agassiz: There is one point to which I should like to call the attention of the Society, and that is, a traveller can almost always judge of the geology of a country by the outline of the land. If one sees the crest of a hill of a certain shape or form, you know it is volcanic. Within 10 miles of it, you may come across a series of elevated limestone, and the character of the country is changed. Take any of the forms which Dr. Davis has presented to us, and it seems to me that some recognition ought to be made of the character of the rocks which are the foundation of different changes. If they were limestone, it would be one thing; if it is modern limestone, it is another thing; if older limestone, still something else, and I think these differences ought to be noticed. No doubt the adaptation of nomenclature to certain definite things does help enormously in understanding them, and I can give, perhaps, no better illustration than in the field which Sir John Murray and myself are mostly interested in—that is, in the marine forms. There was a time when anything that lived in the sea was simply characterised as "marine animals;" as our knowledge has increased, categories have been formed, and the number of names which have been introduced have certainly facilitated the study of the description of them in a remarkable way. It is perfectly true that some authors may have gone a little too far, but, at any rate, no one can help recognizing the fact that this nomenclature defines a great many things. It may mean that the marine animals live close to the shore, or live near the surface. That obviates at once a large amount of description, and we know perfectly well

what is meant by it; something of the same sort is bound to come out of these investigations, and its effect may perhaps be felt even further than Prof. Davis has extended it this afternoon.

Dr. TEALL: It is more than twenty years since I was engaged in teaching physical geography, and my mind has gone back to that time while listening to Prof. Davis. I did my best in those days to get the student to realize how the topographic forms we now see have come about. Since that time Prof. Davis has introduced an enormous amount of precision into this branch of the subject. He has shown how many of these forms can be described very effectively in a few words, provided we know exactly the signification of the terms used; and in these days of rapid accumulation of scientific literature, any one who does this kind of work must confer a great benefit upon all teachers of geography and geology. While realizing all this, I must confess to a slight feeling of discomfort. I feel that if we follow Prof. Davis closely we shall lose a certain amount of literary freedom which is very desirable. But on the main point I am thoroughly with him; that is, as to the necessity of introducing into our descriptions of topographic forms as much information with regard to their origin as possible. I also agree with Prof. Davis when he says that we should not allow our fear of making mistakes to hamper us too much, because it is perfectly easy to call attention to the possibilities of error. His method is one that must set people thinking, and that is, after all, the best way of securing advance.

Mr. FRESHFIELD: I had not thought of saying anything to-day, but I cannot resist congratulating Prof. Davis on the very clear way in which he has made a difficult subject intelligible, and indicated a method which may assist geographical teachers in all countries to interest their audiences and to give them clear explanations of physical phenomena. I see one difficulty in the way, and that is, that where the origin of the surface forms is uncertain, the lecturer's disposition will be to emphasize his own theory. With regard to the work of glaciers to which Prof. Davis alluded, I am not going to argue the general question here to-day. We must agree to differ. But there is one detail I may refer to—the narrow gorges often found on slopes which were at one time covered by glaciers. I believe that they are cut out by the sub-glacial torrent. In Switzerland you may see such gorges at Grindelwald, at Rosenlaui, at the Kirchet near Meiringen, and elsewhere. At the two spots first mentioned the ice has retreated since I was a boy, and we find that in the ground laid bare the torrent has cut very narrow gorges. I attribute their narrowness to the fact that the ground on the sides has been protected from sub-aërial denudation by the ice-cloak lying over it. With regard to nomenclature, I heartily sympathize with much we have heard to-day; but I trust Prof. Davis will use his influence, on his return home, to check superfluous changes and exaggerations in phraseology such as we have recently met with in books of Transatlantic origin.

Mr. MACKINDER: It seems to me that Prof. Davis has rendered very great service to geography by his effort to introduce precise and consistent methods of description into the subject. I feel that one of the chief ends of geography is description, and that view heightens in my opinion our estimate of what Prof. Davis has done. Geography, I venture to think, differs fundamentally from such subjects as chemistry and physics. Systematic physical geography is after all, in large measure, preparatory to the subsequent chapters of the subject which deal with the humane aspect of it. In this discussion we have thus far heard chiefly of the geological bases, although Sir John Murray referred also to the climatic aspect of geography, and therein moved, as I think, towards the conception of geography as a whole which is proper to this Society. Where geography differs from the ordinary

physical sciences is that it has what I venture to call "outlook," essentially a human function, for its chief educative object. What we require in this connection from the geologists and physical geographers pure are modes of description which shall not be merely empirical as hitherto, but based on true distinctions. Here, of course, we have room for original research with a view to the ascertainment of these distinctions.

If geography is to obtain the place which we hope for it in education, whether at the school or university, I think we must be very careful about the terms we adopt. If we are to induce writers on the humane aspects of geography to recognize real physical distinctions, we must seek to use such terms as will fit into literary English writing. I would plead that in the place of long foreign words we should give a precise sense to strong and, where possible, English words. It is no doubt easy, when you are talking to experts, to describe with precision by the use of a technical jargon. It is a very hard thing to write a good plain English sentence. But if we adopt the easier method, and shirk the harder, then geographers are throwing away a great opportunity which lies before them. The opportunity is that of making precise the thought and the language of the practical man of affairs, whether he be politician, or writer, or merchant, or soldier. You can move by your subject, as by the cognate subject of history, the whole Anglo-Saxon race in a rational direction. For this reason I care far more that our terms should be harmonious to the ear and powerful, than I do as to whether they are genetic or analytic. There are words, like "peneplain," which are not beautiful. There are others, often taken from English dialect, such as "scree" and "crag," which will be accepted readily by the literary writer. For this reason and for others we must, I think, resist the temptation of making geography into a merely supplementary chapter of geology. We must adopt freely from geology, but always in such way as to lay with truth and accuracy foundations for our own proper work. We welcome with admiration the work which Prof. Davis has done in the field of genetic terminology, but he will forgive me if I venture to except a few of the terms which he has selected.

Dr. Mill: It is always a pleasure to hear Prof. Davis expounding his theories of the origin and progressive modification of geographical forms, and it has been my privilege to hear him do so in the presence of some of the most remarkable scenery of the world. Such an exposition has always filled me with admiration of his power of presenting facts and bringing them into harmony with the geographical cycle. Without wishing to introduce any discordant note into this discussion, I must say, however, that the geographical cycle requires Prof. Davis to use it to perfection. It is a method that seems to me peculiarly dangerous when it is attempted with imperfect experience. Prof. Davis has so vast and clear a knowledge of the surface forms of the Earth, and of the geological processes that have led to the existing scenery, that he can safely use methods which, in the hands of another, might lead to erroneous conclusions. His method appeals to me as one more for the master than the student, and I am afraid that his disciples will run away from him, and apply it in a way that will cause him anxiety at first and horror afterwards. We must, speaking as geographers, go to our friends the geologists for information as to the past history of land-forms, and the practical problem which comes before me is to know to which geologist we are to go. I have sometimes attended a meeting of the Geological Society, and retired from it with a sad suspicion that even the geologists themselves are not always of one mind as to the processes by which land-forms assumed their present shape. Prof. Davis has a magical power of putting his theory before us. These diagrams of his are a real revelation in blackboard work, and if we could only get those elusive geologists

within our grasp, and draw from them the real truth as to the past, there could be no finer way of presenting geography, so far as the land-forms look towards their origin. Of course I agree with Mr. Mackinder that the geographical cycle is only the beginning of the matter; and for myself I must say that what attracts me most in geography is the influence which the land-forms exercise upon the other agencies which are at work upon the Earth's surface.

Dr. HERBERTSON: Every one must agree that any morphological classification of land-forms must be a genetic one, and based on an investigation into the history of the land-forms. Prof. Davis has shown us this afternoon that this can be described in good, clear, intelligible English terms. It is necessary, however, to distinguish between the use of terms in morphology and geography. If we are dealing with land-forms, then we must have this genetic account in precise technical terms. It seems to me that for this systematic description and terminology we require to devise something of a much more simple yet more comprehensive character than a series of descriptive terms. We might have recourse to letters and numbers, as the chemist does, and use, say, numbers to indicate different types of structure, letters to show the process of denudation, and another set of symbols to indicate the various stages in the evolution of the cycle of denudation. For instance, the late mature stage of volcanic plateau denuded by running water might be 2*a*8. This would be a means of recording in simple and intelligible form the story which, after investigation, the morphologist was inclined to tell of a particular land-form.

It must be remembered that Prof. Davis has been dealing with what, for the geographer, are land-forms of the smallest order. We must also recognize that there are many orders of land-forms, and the geographer is concerned far more, except in purely local and very detailed investigations, with the larger orders of land-forms. It seems to me, we must tackle the problem also of the point of view of big divisions of the world, as well as from the detailed study of the minor forms, of which we have had such a fascinating example from Prof. Davis to-day. I have ventured to make a very rough map which shows the great structural divisions of the world and the main processes which are going on at the present day. This particular map, of course, does not give us a picture of the actual stage of the evolution of those particular types of land-forms, but it does give one of structure and process.

There is also the question of the employment of the technical morphological terminology in geography. I find that the more I work at geography, the less I use morphological classifications and their terms. Whether I am dealing with land-forms, or plants, or man, I find I have to give up the morphological terminology in favour of one that is rather descriptive of function, or, at any rate, expresses the character of the form in terms of the influence that the form exerts on the other geographical features rather than on the history of the form—to deal with vegetations rather than floras, with economic or culture groups rather than with races. So that while, as a morphologist, I am extremely interested in all Prof. Davis has said, as a geographer I sympathize with Mr. Mackinder. I believe we must employ, for most geographical purposes, characteristic physiological descriptions rather than purely genetic morphological terms.

Dr. STEIN: I was, unfortunately, not able to be present when Prof. Davis gave his lecture, but I have read his abstract with the greatest interest, and I feel convinced that if the genetic method of which he has given such a clear exposition here were sufficiently introduced and known in educational circles, those who are drawn to geography at a more mature age would find themselves far better equipped for observing new facts and for presenting what they have observed. The mere fact of having to refer to physical features by terms implying a certain explanation would help everybody who is called upon to observe new ground, in sifting and clearly

expressing his observations. At the same time, I am much impressed by the remarks which Mr. Mackinder has made as to the desirability of avoiding too technical language. I think it is a considerable asset to geographical study that has always been successful in attracting students from other departments, and in their case, I am certain, the less technical the terms are, the more they will be able to enter into the spirit of investigations. Plain Anglo-Saxon terms, such as Mr. Mackinder has been quoting, may not always be morphologically correct. But they are likely to convey to the reader a graphic impression even when he may not have an opportunity of acquainting himself with theories as to the origin of the particular land-forms meant. I am sorry I am not able to go into details, but I fully realize the gratitude we owe to Prof. Davis for having taken the trouble to set forth his views here with his well-known lucidity and such admirable illustrations.

Mr. Lamplugh: Every geologist recognizes Prof. Davis as a geologist who has lent himself to the geographers for their benefit, and who looks at things essentially from a geological point of view. Such common terms as 'hill' and 'valley' always carry more than their simple descriptive meaning to the geologist, who, from the first, has recognized that the features they denote have a history and can be explained. Therefore this attempt to bring the geographers to use a technical language implying the explanation is merely asking them to recognize that there is an inhuman or geological side as well as a human side to their science. But I think that in the actual application of the terms there should be no possibility of misconception; and one point has struck me as likely to cause difficulty to the geographer. Prof. Davis defines his cycle of erosion as starting always from a particular baselevel. Now, in small areas such as those dealt with in the demonstration to which we have just listened, the results are perfectly clear and obvious, and there can be no difficulty as to the progress of the cycle. But if the cycle is to apply to every part of the whole country that is brought at a certain time under the influence of a certain baselevel, I do not think that the terms of the cycle will express accurately the land-forms for more than a small portion of such a country. In a large area where the rocks are not homogeneous, but of very different durability, as in the case of the British Islands, the forms characteristic of youth, maturity, and old age will present themselves simultaneously; and the same overlapping of the typical stages will be revealed as we pass into the interior of an elevated land which has a distant external baselevel. I am sure that Prof. Davis will have considered this objection, and will be able to meet it; but I think that the theoretical simplicity of his scheme can be realized only in small areas, and will become difficult to follow amid the complexities of a large tract.

Dr. Evans: I am glad to have the opportunity of joining in the welcome to Prof. Davis. He is not a stranger to any of us, but it is a privilege to have him here to expound his views in person. His principles of nomenclature are those of all sciences. A man who believes he has discovered a theory which will account for certain facts naturally wishes to employ a nomenclature which expresses that theory; and this has obvious advantages. A mere collection of facts is not easy to remember, whereas in a description which embodies a theory of the writer the facts are bound together by a connecting principle. There are drawbacks to this procedure, but I do not think that there is really more danger of its abuse in geography than in other sciences. On the other hand, in the wide field of study which considers the influence of the contours of the surface on meteorological and other phenomena, the genetic nomenclature is not applicable, and we must have recourse to the older names, which express simply the orographical features without regard to their origin.

Prof. Geddes: May I plead with Prof. Davis first to fix for us our terms of

popular language as far as they will go, and then fearlessly to add his terms of technical detail as far as need be? Further, will he help us in some way to clear up the nomenclature of city situations? I have struggled for some years to prepare a paper on these (which I should like to lay some day before this Research Department), and I feel therefore the need of an orderly terminology, which I am sure his method can supply us.

The Rev. E. C. SPICER said that nomenclature was not geography, but philology. It was difficult and in some cases impossible to force a new word into the mosaic of a language already established by usage.

Prof. DAVIS: Sir John Murray was good enough to refer to two of my papers on the classification of lake basins: the second one, much less elaborate than the first, may be regarded as a translation of the earlier partly explanatory method of treatment into a more thorough-going explanatory method, with the scheme of the cycle for its base. The transition from one method to the other is simply a phase of development which has been carried farther in the method of structure, process, and stage, as outlined to-day.

Mr. Agassiz remarked on the importance of rock structure. This gives support to my plan, which places rock-structure as the first element of the systematic method here explained; it is essential always to have good understanding of the mass upon which the external processes work, but it may be remarked that, as the stage of erosion advances, the influence exerted by structure usually becomes weaker and weaker.

Because even a good thing may be overdone does not argue against its value when properly used; hence I do not feel discouraged by Mr. Teall's fear that the method of structure, process, and stage may prove a restriction upon the desirable freedom of the working geographer. Of course, if it is used in a restrictive manner, it may grow to be injurious; it surely would be injurious if it became the object and not the means of our work. But the safeguard against this danger is not to give up method altogether; the better safeguard is simply to be reasonable about it—and as to what is reasonable, every investigator must, of course, judge for himself. For similar reasons, I cannot attach importance to the fears expressed by Dr. Mill; we should make little progress if we refused to introduce improvements because the ill-informed or the ill-advised might misuse them. The correction that I should like to see for such a danger is to improve the methods and the amount of geographical instruction, and when necessary, to raise the standard of articles accepted for publication by geographical societies.

Dr. Herbertson points out that it is necessary to describe large geographical features as well as the relatively small forms that I have been describing this afternoon, and implies that the method of structure, process, and stage will not suffice in the former case, though it may in the latter. The insufficiency of the systematic method for the description of large areas has not yet been demonstrated; and it can be demonstrated only by competent experiment. I commend this experiment to Dr. Herbertson, for I believe he may find it unexpectedly successful. The trials that I have made myself, in writing and lecturing on the larger features of North America and Europe, encourage me to go on with further development of the systematic method for the description of large forms as well as of small. In any case, however the larger features are to be described, they can be correctly described only after a good understanding has been gained of the smaller features of which they are made up; and to promote this understanding, I believe there is nothing so effective as the thorough-going explanatory method. It must be remembered that no geographer has ever seen the larger features of the world as entities; he has only seen them piecemeal, each piece being only so much as may be contained in

a landscape; and his knowledge of the whole is therefore acquired only by putting together the many separate landscapes. There is nothing in the nature of the case that requires the resulting generalization to be empirical instead of explanatory; and my own opinion is that just as our ignorance regarding details is diminished, so will our capacity to give an effectively generalized explanatory description of the whole increase. As to the decreased use of morphology in Dr. Herbertson's geographical studies, I fancy that is simply because he is attempting brief descriptions of large areas instead of detailed descriptions of small areas. If he wrote an elaborate geography of Italy for mature scientific readers, the chapter on the Riviera would necessarily be morphological.

Several members who took part in the discussion directed their remarks to the terms employed in connection with the method of structure, process, and stage, rather than to the method itself. I infer from this that they accept the method but wish to modify its terminology; and I shall therefore watch with interest their future writings, to see how far they express this tacit acceptance in their practice, and how many improved terms they introduce. Dr. Stein thought we must avoid too technical methods, and I think so too; but I am not sure that we should agree as to what is too technical and what is just technical enough. He thought plain Anglo-Saxon terms desirable. Does that mean we should give up delta, atoll, glacier, moraine, drumlin, meander, steppe, prairie, tundra, volcano, lava, wady, and many other terms for which plain Anglo-Saxon has no equivalent? Does it mean that we shall use Anglo-Saxon words in place of consequent, subsequent, obsequent, grade, aggrade and degrade, and other terms of Latin origin, now often used in the explanatory description of rivers? Such changes would, in my view, be very unfortunate. Geography, like geology, is an international subject and should have an international terminology; and this end is best gained, first, by introducing terms from various languages, so as to avoid too local a quality; secondly, by coining words, when necessary, from classical roots which have an international acceptance. As to taking terms from various languages, I am glad to have the support of Mr. Freshfield, who advises us to retain bergschrund, instead of replacing it with a newly proposed English equivalent; I hope he will therefore also recommend the adoption of nunatuk and monadnock, instead of attempting to make up Anglo-Saxon equivalents. Mr. Mackinder objects to peneplain because he thinks it a hybrid of Latin and English; but in this objection he is wrong. All the philologists whom I have consulted approve the construction of the word, because, like many other standard English words, it retains the Latin prefix unchanged, while it modifies the Latin root. *Complaint* is a case in point, though its root is not the same as that of peneplain; there are plenty of others, such as exploit, constraint, penult, and so on. With the spirit of Mr. Spicer's remarks I fully concur; these various terms, imported or invented, must take their chances in the evolution of language. They ought, of course, to be carefully selected, and their fitness ought to be tested by use, as in lectures and conferences with students, before they are published; they ought not to be condemned simply because they are novel and unfamiliar. But whether they survive or not will depend on their success in the verbal struggle for existence much more than on our wishes.

Prof. Geddes wishes that some terms might be introduced for use in connection with a study of human settlements. I do not know how far he is familiar with the systematic method for the description of land forms that we are discussing, or how far he has experimented with the terms that to-day go with the method; but, in my own work, I find both the method and its terminology effective in the direction that interests Prof. Geddes. Settlements are first determined by relatively local features, and these may certainly be described by the method here proposed;

growth of small settlements to large cities is determined chiefly by larger features in relation to local features, and these larger relations are also best treated systematically. Hence, instead of attempting to invent a new demographic terminology, I should prefer to see serious experiment made with the terminology already existing.

Mr. Lamplugh expressed some doubt as to the possibility of applying the scheme of the cycle to an area like England. The application is impossible if the scheme is taken rigidly, but easy and helpful if the scheme is made reasonable and elastic. It is easy to recognize that a weak formation, like much of the Trias in the Midlands, may be worn down to a smooth lowland, that is, to advanced old age, in the same absolute time that the resistant rocks of central Wales are only maturely dissected; that uplift may be of greater measure in one part of the country than in another; that one part may be glaciated and another not. In all this, the method merely attempts to express the facts of the case systematically, be they simple or complicated. A short lecture does not suffice to present nearly all the aspects of the scheme. It seems fair to expect that most of the difficulties and requirements of a method of description, which suggest themselves to the hearers in a single afternoon, may have been considered by the speaker in the course of several years, and that some credit should be given for complications and details which could not be presented in an hour, and which nevertheless naturally follow the general plan and adapt it to many particular cases. It must be remembered, also, that the intention underlying the whole effort is not to force the variety of nature into the narrow limits of a rigid and arbitrary scheme, but to adapt a reasonable and elastic scheme to the variety of nature. Were this not the case, there could be no warrant for presenting even an outline before this meeting.

Mr. Lamplugh was further good enough to include me among geologists. I would do still more, for I would regard all scientific geographers as geologists who specialize in the present epoch, because all geography is only the geology of to-day. If this seems to subordinate geography too much to geology, it may be appropriate to add that I regard all geology as only a summation of a vast series of geographies, the chief difference between the present and the earlier geographies being that the one lies directly before us and is therefore open to immediate observation, while all the others are known only through very imperfect records, and are therefore largely matters of inference. To justify this assertion, it suffices to say that a geologist who is making a special study of a certain period would be delighted if he could draw maps of the land and waters of that time, and pictures of the scenery and the inhabitants, such as the geographer draws for to-day. The geologist often tries to draw just such maps and pictures, and to explain them with descriptive and technical language, and to that extent he becomes a paleogeographer. But from the very necessity of making large use of inference, most geologists have acquired a broader and more scientific training than most geographers; while from the apparent openness of all geographical facts to observation, too many geographers are satisfied to remain mere travellers and narrators. The addition of explanation and correlation to geographical description will, I believe, go far to correct the comparatively superficial character of much so-called geographical work, which is too often hardly more than a personal narrative, preceded by a disclaimer of geographical competence on the part of the author. It is largely with the hope of raising the standard of geographical effort, in so far as it is concerned with land forms, that I have tried to develop a more effective and scientific method for their description.

REVIEWS.

EUROPE.

A Lincolnshire District.

'The Rivers of Axholme. With a history of the navigable rivers and canals of the district.' By Geo. Dunston. *Maps and Plans.* Pp. 155 + xiii. London: A. Brown & Sons. [*No date;* 1909.] 10*s. net.*

The Isle of Axholme covers an extent of some 150 square miles, but in virtue of its former swampy nature has been the scene of few events in history; yet Mr. Dunston has endeavoured, and not without success, to record what there is to say about its past, a task which involves some geographical interest. At one time this region was heavily afforested, but as early as pre-Roman times it underwent submergence, in consequence of which the forests were destroyed. The whole region, including the wide extent of Hatfield Chase, remained in this state until 1626, when Vermuyden began his remarkable series of drainage works that, when finished, completely altered the value of the district. As an engineer, the author naturally pays considerable attention to these drainage canals, and gives a lucid account of them, accompanied by several plans and charts. The Royal Commission on Coal Mining fixed the fringe of Thorne moor as the eastern limit of coal at workable depths, but recently coal has been discovered at Scunthorpe, 8 miles east of Crowle. Mr. Dunston some years ago insisted that all this area is underlain by a vast coalfield. This belief is substantiated by the successful borings that have been made at Idlestop, where coal has been reached at exploitable depths. Discoveries of this nature will materially alter the geographical value of the district, and will be of immediate importance to the North Lincolnshire iron-ore industry.

The second half of the volume is occupied with an account of the navigable rivers and canals which affect the economy of Axholme. These are treated chiefly from an economic aspect, details of dues and rates being given. Mr. Dunston has gone to considerable pains to investigate original manuscripts in tracing the history of Axholme. His enthusiasm leads him to promise a second edition of his book. Should he prepare this he would be well advised to expand, and to give some account of the nature of this neglected region, the activities of the inhabitants, the value of the land, and so forth, and to add a good geographical map. In its present form the volume is rather meagre, and excites an interest which the extent of its pages fails to satisfy.

R. N. R. B.

Ireland.

'Die Oberflächengestalt und Lage Irlands und ihre verkehrsgeographische Ausnutzung durch den Menschen.' By Dr. Hermann Priester. Pp. 103. Stuttgart: Strecker und Schröder. 1909. *Price* 3.50*m.*

This modest volume, scarcely larger, in fact, than a pamphlet, is small enough for a subject of such importance as the influence of position and orography on the economic development of a country. Ireland must be recognized as one of those countries which do not always receive impartial treatment, even in geographical works, but the author of the present study shows no partisan spirit; he gives an excellent presentment of his subject, showing his power to grasp those features of a country which have the controlling influence on its activities. Certain of Dr. Priester's conclusions may be noted. Firstly, with regard to the advantages or otherwise that accrue to Ireland from her proximity to Great Britain. As soon as England became an industrial country, Ireland was in the position of a neighbour

on a lower economic level, and consequently one from which the richer country could gain little. On the other hand, the countries of Europe, on a higher economic value, were ones whose proximity could only be advantageous to England; to these, therefore, she devoted her attention rather than to the west, an occurrence detrimental to the prosperity of Ireland. And thus it was that Ireland found no economic advantage in the union of 1800 until England, becoming more exclusively an industrial country, afforded an excellent market for Irish agricultural produce. But the only part which received any industrial impetus from the association of Great Britain with Ireland was the north-east. It is certainly noticeable that the comparative proximity of English and Welsh coal to all the eastern seaboard of Ireland has been little taken advantage of. Again, Dr. Priester deals with the question of Ireland's canals, showing how well adapted is the country for these waterways; yet there are not many, and these but little used. As a means of cheap competition with railways, canals should be of great service to a country. Once they fall into the hands of railway companies, as one-third of the canals of the United Kingdom do, they of course lose this value. However, only one-sixth of Ireland's canal mileage is railway owned, and yet, except for the Grand canal, little use is made of these inland waterways. Dr. Priester advocates state-ownership. Considering the geographical advantages of her site, Ireland does not, thinks the author, reap all the benefit which she ought, and this mainly for two reasons—firstly, the proximity of Great Britain, which ought to be advantageous, is so only in a one-sided way, since it largely results in Ireland's industry and commerce being crippled; secondly, while world commerce with Ireland cannot develop to a great extent, since Ireland lies in the shadow of Great Britain, yet world-traffic, *i.e.* passenger-traffic, might greatly increase. All Dr. Priester's conclusions may not meet with general acceptance, but that will not lessen the value of this study. His volume is one which cannot be overlooked.

R. N. R. B.

Ice-conditions on Lake Balaton.

'Das Eis des Balatonsees.' Dr. Eugen von Cholnoky. With 21 Plates and 122 Figures. (Resultate der Wissenschaftlichen Erforschung des Balatonsees, I. Band, 5 Theil, IV. Section.)

This memoir forms a further instalment of the elaborate reports published under the direction of a Committee of the Hungarian Geographical Society, published at intervals since the committee's appointment in 1891. (For a review of parts previously published, see *Geographical Journal*, vol. **29**, p. 554.)

Lake Balaton, though about 45 miles long, has a maximum depth of only 33 feet, and a mean depth of but 10 feet. In consequence it freezes very readily, and in severe winters remains frozen for nearly three months of the year. Notes on the freezing of the lake have previously appeared in section 1 of the same division of the reports. The present memoir describes in great detail the different phenomena which accompany the formation of ice.

Lake Balaton is pre-eminently suitable for a study of ice-formation, as its shallowness makes it respond readily to variations in the temperature of the atmosphere, and its large area adds to the importance of the observations. Moreover, Hungary is in winter "the battle-ground of the Asiatic and Atlantic ocean climates." Very rapid fluctuations in temperature are experienced, and these favour the appearance of a number of interesting phenomena. The sheet of ice which covers the lake at times attains great thickness. During the severe winter 1892–3 a maximum of 46 centimetres (18 inches) was observed.

The effect of wind in mixing the water in stormy weather is to retard freezing,

but to increase the ultimate thickness of the ice-sheet. All the water in the lake is brought near the freezing-point before ice begins to form, and the freezing then proceeds rapidly. A covering of snow hinders the increase in thickness of the ice-sheet, as it diminishes radiation from the lake. Clear and open skies promote radiation, and thus increase the rate of freezing.

The manner in which the ice-sheet forms both in calm and in stormy weather is carefully described and illustrated. The rapidity with which the ice-sheet disappears under the influence of winds is also noted, and is most striking. When the ice is beginning to melt, it breaks up into vertical polygonal needles or "candles" (*Kerzen*), called by the Hungarians "Gyertyásodás." When this stage is reached the ice-sheet is rapidly broken up by the wind, and large banks of rotten ice form on the lee shore.

The rapid fall in air temperature which sometimes occurs at night results in a considerable temperature gradient in the ice-sheet itself, and the temperature of the surface of the ice-sheet may be from 5° to 6° C. lower than that of the bottom. The local contraction of the ice due to this rapid cooling produces fractures, which occur with loud reports. The dynamics of these fractures is discussed, and the places at which they occur in Lake Balaton are carefully charted.

The free water in these cracks again freezes, but owing to the expansion and contraction of the ice-sheet large blocks of ice are forced up and form rugged walls of ice where the fractures have taken place. These ice walls are locally called "turolas." The chapter on the dynamics of the ice-sheet concludes with a discussion of the comparison which has been made by E. R. Buckley and Van Hise* between the formation of these "turolas" in ice-sheets and of mountain ranges in the Earth's crust. Although such a comparison is interesting, the difference between the forces at work and between the physical characteristics of the ice-sheet and the Earth's crust must be kept clearly in mind. The last chapter of the memoir describes and illustrates the phenomena which accompany the covering of the ice-sheet with snow.

Dr. Von Cholnoky makes no reference to the effect of the freezing of the lake on climate, but this must be quite appreciable. During the period of freezing a considerable quantity of latent heat is set free, and when the ice melts in spring a considerable quantity of heat is absorbed. The result of this is that in the neighbourhood of large lakes, which become frozen over, a spell of frost tends to be less severe at its commencement, but to continue longer, than over dry land.

E. M. W.

AFRICA.

Ethnography of German East Africa.

'Mitteilungen aus den deutschen Schutzgebieten, Ergänzungsheft Nr. 1: Wissenschaftliche Ergebnisse meiner Ethnographischen in den südosten Deutsch-Ostafrikas.' By Dr. K. Weule. Berlin: Mittler u. S. 1908.

The author of this well-illustrated quarto volume was a member of the *Kommission für den landeskundigen Erforschung des deutschen Schutzgebieten*, and to him fell the task of collecting ethnographical *data* on and around the Makonde plateau, which lies in German East Africa between the Lukuledi and Rovuma rivers, the 39th parallel of east longitude and the coast; while his two colleagues were concerned with geographical exploration further north. The main interest of the work is ethnographical; the geographical portion consists merely of an outline

* *Trans. Wis. Acad.*, 1900, vol. **13**, part i. p. 141.

of his route together with a few photographs of typical landscapes. That route took him from Lindi along the Lukuledi, and then, skirting the plateau, south to Newala, not far from the Rovuma; here he mounted the plateau and struck north, eventually hitting the Lukuledi not far from its mouth. The tribes with which the book deals are the Makonde, from whom the plateau takes its name, and the scattered groups of Wayao, Wanyassa, and Makua found in the plains to the west and south-west. Of these the first-named afford by far the greatest interest; less is known about them, and their culture has been less influenced by the coastal peoples. In particular the division into matriarchal exogamous groups, which has almost disappeared among the other tribes, is here found in full force. The great feature of the work is a very full description of the puberty ceremonies relating to both sexes in force among Wayao and Makonde, and Dr. Weule is to be congratulated on having secured a far more detailed description of these performances than usually falls to the lot of the student of more or less secret rites. Of particular interest are the remarkable masks employed by the Makonde on these occasions, many of them covering the upper part of the body as well as the head, and representing women; the use of stilts in ceremonial dances was also found here. The author also collected an unusual number of traps used for the capture of birds and mammals, small and large, besides other specimens representing almost every branch of cultural activity. Of his general observations one of the most interesting is his remark that the use of the lip-plug, so prevalent throughout this area, is a very potent cause of decay in teeth, to which the Makonde seem liable in a degree unusual amongst a primitive people. At the end he pleads for an attempt to introduce a more hygienic manner of life amongst the native tribes, the want of which lies at the root of the sadly high percentage of infant mortality. The book is illustrated by sixty-three admirable plates, mostly in collotype, to which a special word of praise is due; and the extreme lowness of the price (3*m.*) at which it is issued bids one suppose that here again the German Government shows wisdom in subsidizing the publication of works which help to set administration on a scientific basis. Not the least valuable of the accompanying features of the volume are an excellent map in colours and an adequate index.

T. A. J.

The Sanga-Shari Borderlands.

'La Decouverte des Grandes Sources du Centre de l'Afrique.' By Commandant Lenfant. 115 *Illustrations and a Coloured Map.* Paris: Hachette et Cie. 1909. 12*fr.*

In the introduction to this volume Commandant E. Lenfant states that when he was a lad the reading of the exploits of David Livingstone and H. M. Stanley fired in him the desire, like them, to penetrate into the unknown. That wish he has gratified, and to-day he occupies a place among the foremost of the followers of the great African explorers. In 1903 he demonstrated the water connection between the Benue and the Logone; the expedition of 1906–7, of which we have here the general account, was devoted to the investigation of the district containing the western sources of the Shari and the upper waters of the Sangha. The chief results obtained, including the discovery that the Whame-Bahr Sara is the parent stream of the Shari, have already been noticed in the *Journal*. A technical treatise on the geographical work of the mission is to come from Captain Periquet, but a summary thereof appears in this book, which also contains general descriptions of the country traversed, studies of the peoples encountered, and the adventures of the mission. The region explored is divided into three zones: (1) the southern, or basin of the Sangha, a land of dense forest; (2) the central, a rocky plateau; (3) the northern, or plains of the Logone, a grass-covered open land with

clayey soil (the bed of some forgotten lake). The exploration of the central zone, called the *Massif de Yade*, was the great achievement of the mission. In the belief of the author, this granitic mass, fairly level in the centre, but presenting abrupt sides with many peaks, is the hard core which has resisted the wearing away of the land which surrounds it. From it "as from an immense reservoir" rise "all the rivers which water Central Africa." The statement, which is an obvious exaggeration, is reflected in the title of the book, but from this hydrographic centre issue the headwaters of the Sangha, the Logone and the Shari, and of the Lom or Sanaga. Commander Lenfant shows clearly the effect of the nature of the country on the life and morals of the inhabitants. Thus in the dense forest zone of the Sangha, where no domestic animals thrive and few exist, the natives (Bayas, Yanghérés, etc.) are anthropophagus, and live largely on manioc; in the northern zone, where herbage is abundant, cannibalism is not practised, the inhabitants (M'Boums, Lakkas, Saras, etc.), possessing large herds of cattle, and raising plentiful crops of millet. Naturally, this latter group of peoples is superior to the first group both in physique and culture. The ethnologist will indeed find Commandant Lenfant's pages full of information and suggestion. He discusses the question of cannibalism with an interesting detachment and in the spirit of a social reformer. He holds this practise to be "the son of necessity rather than the result of fetishism." In short, anthropophagism is the palliative "des chasses infructueuses, du bétail absent et de ce que les indigènes appellent le 'mauvais goût dans la bouche.'" The use of this expression by a tribe is, indeed, an almost absolute proof that it practises cannibalism, the "bad taste" being caused by the absence of sufficient salt in their food. An extremely interesting chapter is devoted to a description of *labi*, a term which indicates a special mental, moral, and physical training which many young men of many different tribes undergo. There is a special *labi* language, a sort of Esperanto, which thus becomes a general means of communication. Space does not permit even mention of other subjects dealt with in this really fascinating book. We can only add that the illustrations are many and good. The map, which is based on some 180 positions astronomically determined, shows clearly the river courses, but no heights are given. From the text it appears that the highest points are about 4000 feet above sea-level.

F. R. C.

The Canaries.

'Les Iles Canaries.' By L. Proust and J. Pitard. *Illustrations and a Map.* Pp. 320. Paris: Guilmoto. [*No date;* 1909.] *Price* 10 *fr.*

The two authors have succeeded in writing a pleasant descriptive work on the Canary islands, in which they have omitted no aspect that could be of interest to the visitor or casual traveller. The book is certainly far above the standard of an ordinary guide-book, and yet, despite its comprehensive nature, can scarcely make serious pretensions to geographical merit. The flora is the only aspect of the islands which receives anything like adequate scientific treatment. A description of the islands, their peoples and activities, occupies the greater number of the pages, and only a brief chapter is devoted to physical geography. The origin of the Canaries as being the remaining tops of the lost continent of Atlantis is advocated, and proofs are adduced from the botany of the islands in support of the theory. But to the authors' mind the indisputable proof is to be found in the absence of Tertiary beds in the Canaries, because during all this epoch the islands were above the sea. The presence of limestone beds in the islands is certainly evidence of their past connection with a larger land-mass, possibly northern Africa; but the authors have scarcely given convincing proofs of the existence of Atlantis.

A long account is given of the Guanches, who to the authors are the descendants of the inhabitants of Atlantis left on the mountain-tops when that land foundered; in this flight of imagination the origin of the Guanches is dismissed, and we pass to a description of their life, habitations, occupations, and customs.

However, we can scarcely complain of such casual treatment of an important problem in a book of this nature, which makes no claim to be a scientific volume. The volume will be of value in supplementing more serious scientific and historical works on the Canaries. There are some well-reproduced photographs, but the map is a mere plan on which no physical features are shown.

AMERICA.

Later Phases of the Pelée Eruption.

'La Montagne Pelée après ses Éruptions.' Par A. Lacroix. Paris: Masson & Cie. 1908.

In this volume we have a supplement to the great monograph on Pelée by the same author which appeared about the close of 1904. Since that date there has been no considerable eruptive activity in Martinique, but many interesting geological changes have taken place. Under the auspices of the French Government, the observatory which has been established near the mountain has been continuously engaged watching the closing stages of the volcanic episode, and recording seismic, meteorological, and other phenomena likely to be of scientific interest. In this work, Prof. Lacroix has gathered the results of all the available observations, and shows what light they throw on the novel type of eruption first brought to the attention of scientific men by the disaster which overtook St. Pierre in May, 1902. By the end of 1904 the volcano was again almost in a quiescent state, and this has continued up to the present time, with only a few unimportant interruptions. In June, 1905, it was feared that a great outburst was impending, and a "black cloud" was emitted on the 11th of that month, but this was not followed by any serious consequences.

The most interesting feature of Montagne Pelée to vulcanologists is the great dome of solid lava which swelled up gradually out of the active crater, too viscous to flatten out or to flow, though plastic and red hot in its interior. From its summit at one time a lofty spine or column of andesite or dacite towered to a height of nearly 1000 feet. The whole mass is now so cold that its surface can be walked upon in safety. It is greatly changed in shape; the spine is practically gone; the dome has cracked and split up till it is covered with angular *débris*. At one time, when the spine was highest, the mountain had an altitude of 1620 metres. Now it is only 1355 metres, which is about 135 metres greater than the altitude before the eruptions. Other changes, almost equally startling, have taken place all over the slopes of the volcano. By the destruction of the vegetation the friable volcanic rocks have been left unprotected, and an enormous amount of erosion has been produced by the heavy and sudden tropical rainstorms. In the city of St. Pierre, some of the more important thoroughfares have been cleared of ashes and mud, and a start has been made in the work of repopulation by the opening of an hotel for the use of visitors.

In the concluding part of the book, Prof. Lacroix shows very conclusively that the destruction of Pompeii was not the work of a Peléan eruption, characterized by the emission of a heavy, incandescent cloud, but merely the consequence of an outburst very similar in type to that which buried Ottajano in ashes in the year 1906, though no doubt more violent.

J. S. F.

AUSTRALASIA AND PACIFIC ISLANDS.

Ethnology of New Guinea.

'Nova Guinea. Résultats de l'Expedition scientifique Néerlandaise à la Nouvelle-Guinée en 1903 sous les Auspices de Arthur Wichmann, Chef de l'Expédition.' Vol. 3, 'Ethnography and Anthropology,' by G. A. J. van der Sande, Surgeon Dutch Royal Navy. *With 50 Plates, 216 Text Figures, and a Map.* Leyden: late E. J. Brill. 1907.

The third volume of the fine series of reports of the Netherlands scientific expedition to New Guinea in 1903 under the leadership of A. Wichmann is devoted to an account of the anthropological investigations of Dr. G. A. J. van der Sande. The expedition appears to have visited various parts of the northern coast of New Guinea from about long. 134° E. to 141° E. and to have penetrated into the interior in one or two places, notably to Jamur lake in the neck south of Geelvink bay, and to Sentani lake near Humboldt bay. As the investigators travelled over such an extensive area and often had but a limited time at the places which they visited, the original observations must be considered as being more of the nature of a survey than as a detailed study. Accepting this position, the author is to be congratulated on having made a noteworthy contribution to our knowledge of Papuan ethnography. He is a keen observer, and records with accuracy and precision what he observed; in addition, he gives, wherever possible, the technique of the manufacture of the various objects, a subject which is too often ignored by travellers, as well as the native name for the whole object and for its various parts. Extensive collections were made, and every object figured in the plates is carefully described. References are made copiously to other observers, not only as regards Netherlands New Guinea, but for New Guinea as a whole; the book is thus not merely a record of observations and a description of objects, but is to a large extent a monograph of the ethnography of New Guinea, and, from both points of view, it is a work that will prove indispensable to all students of Melanesia, and one which must be consulted by all who are interested in technology and physical anthropology of backward peoples. Those who are responsible for the production of the book have illustrated it with a liberality that is as wise as it is uncommon. The title-page modestly speaks of "216 text figures;" as a matter of fact, the majority of these are large reproductions from photographs printed on plate paper, and are technically "plates." The subject of the photographs was carefully selected, and it is evident that the photographer was an expert in ethnographical photography, as he has selected a good point of view, and has produced sharp pictures which really do illustrate the matter in hand. Many of the photographs were taken to show how objects are made; thus one series shows the loosening of bark from the tree-trunk, the first and second beating of the bark, and the bark-cloth hanging up to dry. The plates at the end of the volume are produced in first-class style, and enable one to gain an adequate idea of the collections made by the expedition. A noteworthy feature is presented by the twenty most excellent plates of full-length photographs of natives, giving seventy-seven figures.

From what has been said above, it is evident that the material culture of the people visited has been recorded in a praiseworthy manner. Decorative art has received considerable attention, and as the author was careful to make inquiries in the field concerning the significance of carvings and patterns, he has been enabled to correct the suppositions of museum students in Europe. Perhaps some day the latter will awake to the fact that the time spent in these armchair studies could be much more profitably occupied. Only natives can explain the meaning of the majority of designs and patterns, and not even all of them are sure as to what was meant by the artist in every case.

The drawbacks mentioned at the beginning of this notice have nowhere made themselves more manifest than in the sections dealing with the social life and religion of the natives. For the study of these a knowledge of the language is of first importance, and their investigation demands special aptitudes, a preliminary training, and methodical research in the field, as well as the expenditure of a considerable amount of time. Dr. Van der Sande frankly acknowledges that his information is imperfect. Of totemism and animism he did not find a trace, and in Netherlands New Guinea the bullroarer is met with only among the Tugeri, who live in the district near to the Netherlands-British frontier. The influence of sorcerers is also, in Netherlands territory, restricted almost entirely to the west. The expedition confirms the conclusions to which serious students at home have arrived after the perusal of the results of many other similar efforts, which are, that special methods are necessary for the efficient study of the social conditions of a people. The present writer would be the last person to criticize his colleagues in the field, and he gratefully acknowledges the numerous and interesting results collected by Dr. Van der Sande; but once more he would urge that the time has arrived for the intensive study of limited areas. We have at the present time a fairly good general knowledge of what obtains among the main peoples of the globe. What is now needed is an exhaustive study of the individual and social life of the members of a given community, and of their ideas and ideals. When once a limited community has been thoroughly studied, the field ethnologist can investigate neighbouring communities in a much shorter space of time. The first problem to solve is the social structure of a community, and this can be most readily and accurately accomplished by adopting the genealogical method of research which was initiated by Dr. Rivers when on the Cambridge expedition to Torres Straits (cf. 'Reports,' vols. 5, 6). The kinship system and the social organization can easily be ascertained in this way. General statements by natives concerning the functions of certain individuals in family or social life are of value, but these can be checked only if this method is adopted. Rules of exogamy or endogamy, prohibited degrees of marriage, and the like, can by it be proved. One generally finds that only certain individuals can perform particular functions in the life of the individual or family; the genealogical method generally suggests a reason for this. The same, too, applies in the case of the ceremonies of the larger community, whether they be what are termed "social" or "religious" (though, as a matter of fact, it is often impossible to discriminate between these two). Function is usually dependent on structure, and it is necessary to understand the latter in order adequately to describe the former.

A. C. Haddon.

POLAR REGIONS.

Antarctic Pictures.

'National Antarctic Expedition, 1901–1904.' Album of Photographs and Sketches, with a Portfolio of Panoramic Views. London: Published by the Royal Society. 1908.

The pictorial output of the National Antarctic Expedition was one of its strongest features, as, apart from the admirable colour-work and pencil sketches of Dr. Wilson, there were several separate series of photographs produced by enthusiastic and capable amateur photographers. Lieut. Skelton was responsible for the largest number of these, Lieut. Armitage, Lieut. Royds, Lieut. Shackleton, Mr. Bernacchi, Mr. Ferrar, and Mr. Ford all added important contributions. Many of the illustrations have been utilized in the memoirs on different branches of the scientific work and in Captain Scott's narrative of the expedition, but it was felt to

be desirable that a selection of the most typical representations of scenery, animal life, and natural phenomena should be made and published to form a permanent record. For this purpose, the reproductions of photographs, both by the half-tone process and by photogravure, are printed on a specially made pure rag paper which possesses qualities of permanence not found in the highly loaded "art papers" usually employed. The result is to gain in permanent value at only a slight sacrifice of brilliancy. The negatives employed were so good that the impressions as they now appear lack neither clearness of detail nor depth of atmosphere, forming perfect records and often beautiful pictures. The abandonment of the highly surfaced but perishable paper now so much used is an example which should be generally followed in similar publications where permanence is an important desideratum.

It is difficult to say which of the various groups of photographs are the best or most valuable. The mountain views were naturally the most difficult, and we must confess that Mount Erebus fails to present the grandeur of outline which descriptions had led us to expect. On the other hand, Mount Sabine makes a wonderful picture, and the stratified rocks in the Royal Society Range are as striking as in a geological diagram. Photographs of the edge of the Great Barrier and of details of the surface of the inland glaciers, are amongst the finest pictures of ice-forms which we have seen. Seals apparently do not make good sitters, alive they are shapeless masses, and dead their attitudes are ungraceful in the extreme; but the penguins might be professional models from the grace with which they pose, and when looking at the photographs it is difficult for us to believe that they were not consciously trying to look their best before the camera.

A special feature has been made of fixing the position from which each picture was taken, and Dr. Wilson was fortunately able to undertake the task of marshalling and describing the collection, which he does fully but concisely. The importance of marking the positions of the pictures on the map is greatest in the collection of panoramic sketches, which is enclosed in a separate portfolio. This includes views of the great mountain range along which Captain Scott travelled with Lieut. Shackleton and Dr. Wilson on his memorable southern journey.

Dr. Wilson must be congratulated on the brief but sufficient notes with which he accompanies the illustrations, and for the references to the various publications in which fuller descriptions are to be found; the success of this collection as an epitome of the region visited amply confirms the wisdom of the Royal Society in confiding the work to a member of the expedition with special knowledge of the subject.

H. R. M.

GENERAL.

Densities of Population.

'Beiträge zum Problem der Volksdichte.' By R. Trounier. Stuttgart: Stricker & Schröder. 1908. *Geheftet* 2.80 *m.*

The newer studies of the relation of man to his environment have led to attempts, especially among German students, to extend and intensify the application of the study of relative densities of population, but the results attained have not yet inspired much confidence; intensive study has found itself confronted with great, perhaps insuperable, difficulties.

The calculation of density of population over large areas in a broad and admittedly rough fashion has given interesting results, as Bartholomew's Survey Atlas of England and Wales shows to any one who compares the map of Density of Population with the maps coloured to show vegetation, minerals, and so forth. Difficulties,

on the other hand, crop up when the attempt is made to treat parishes and small areas in this way, and to argue from smaller totals and smaller percentage differences. Does the population of the parish derive its subsistence from the area in question? Are there large estates or even houses of the moderately rich who may spend only a part of their time in the parish, and may even be away when the census was taken? Is there a floating unestablished population in addition to that really belonging to the parish? Many such considerations must be borne in mind, and obviously we may be dealing with quite different conditions even in two closely adjacent districts, which may be on the same type of soil, and may happen to have the same density of population.

Tronnier devotes a large, a rather too large, part of his essay to an exposure of the dangers attendant upon the methods of Eduard Wagner and others who argue that forest areas should be deducted in each parish before the density of population is calculated. All are agreed that where a parish is very largely forest, the population is likely to be small and concentrated at a few spots; but we must beware of assuming a merely negative influence of woodland on population. A woodland may support a considerable population around its edge in districts which, being open, will be apt to be classed as agricultural.

In the latter part of his paper Tronnier shows that before drawing conclusions for any district, either as to actual conditions, or as to the physical or historical origin of those conditions, it is well to study several things. One must know what are the populations concentrated in towns and villages, and discriminate in many cases between these and the people more directly on the land. It is also important to distinguish the child population from the adult population. The "two-children system" of France gives an average of thirty-seven children for a village with a hundred adults; the German "three-children system" allows fifty-three or thereabouts, and the relative numbers also depend on the rural or urban character of the parish, being higher in the country, on the fertility of the soil, and on the presence or absence of a large unmarried element, such as a garrison or a university supplies. One must also separate the directly industrially productive inhabitants from their dependents, *i.e.* families, servants, and agents of supply.

The essay is an interesting example of manifold treatment of a set of statistics from different points of view. It is critical throughout, and shows that the study of density of population is likely to become scientific only in a broad sense, and subject to important restrictions.

H. J. F.

Life in the Navy.

'Two Admirals, Admiral of the Fleet, Sir Fairfax Moresby (1786–1877), and his son, John Moresby. A Record of Life and Service in the British Navy for a Hundred Years.' By Admiral John Moresby. London: Murray. 1909. *Price* 14*s. net.*

The story of the services of that fine old officer, Sir Fairfax Moresby, and those of his son are both worth telling. Sir Fairfax was best known for the gallant way in which he won the Maria Theresa Order in the Adriatic, for his able command of the *Canopus*, and for his excellent management of the Pacific station, especially with reference to his intercourse with the Pitcairn islanders. It was in those days that the present writer had the honour of making the acquaintance of Sir Fairfax and his officers. Many a happy hour did he pass with them on board the old *Portland*: Jack Sheers, Marcus Lowther, Parkyns, Rowley—above all, Palmer and M. Fortescue Moresby. What a charming set of fellows they were! Sir Fairfax was fortunate with his officers, but his popularity was equally well deserved on shore, and the Chilians were not slow to recognize it.

John Moresby was not in the *Portland;* he was then up north with Captain Frederick in the *Amphitrite.* He first went to sea in the frigate *America,* serving under Captain the Hon. John Gordon; but he calls her the *Xenophon,* as if she had better be disguised by reason of her desertion. That desertion was a disgraceful proceeding, but it was no affair of the officers, who were as fine a set of fellows as ever sailed. They beat us in a cricket match at Callao, an honour to which no other ship on the station ever attained. In the latter part of her commission the *America* was commanded by Captain Maitland, a very smart officer, and in that ship John Moresby became a sailor. He next served in the Mediterranean on board the *Odin,* sister ship to the *Sidon,* two paddle-wheel steamers with curious armaments and fully rigged as sailing ships. Captain Pelham of the *Odin* was a fine officer, afterwards a Lord of the Admiralty. It was then that the present writer first knew John Moresby, sixty years ago. He had known his shipmates Leveson Somerset, Blomfield, dear Frank Lambert, and Gallows Jones long before. In the *Odin* John Moresby completed his time. He passed, and after four years in the Pacific again, he served in the Baltic under Sir Arthur Cochrane.

Moresby tells the story of all this service remarkably well. It is interesting and pleasant reading. A spell at Queenstown as flag lieutenant to Admiral Chads, his father's old flag captain in the *Portland,* brought him his promotion, and as Commander he had two commissions in China during stirring times.

It is the geographical side of his life-story that has most interest for us. He strove, no doubt, to follow in the footsteps of his distinguished father as a naval officer, but it is from his uncle of the East India Company's service that he derived his zeal for discovery. The name of Robert Moresby should be well known to all who navigate the Red sea. He was the first to survey the northern half of that long gulf. His noble resolution, most zealously seconded by his officers, was that the Red sea survey should be as perfect as labour and skill could make it. Moresby's survey has guided thousands of steamers up and down one of the most important, and at the same time, one of the most intricate, routes in the world.

Robert Moresby's next great service was the survey of the Coral islands which cross the track of Indian trade, the Maldives, Chagos archipelago, and Saya da Malha bank. Charles Darwin, in the preparation of his work on the structure and distribution of coral reefs, received much assistance from Captain Moresby. One section of his chapter on atolls is devoted to the Maldives and the great Chagos bank, and the information he received from Captain Moresby enabled him to give accurate and very interesting descriptions of these coral formations.

When John Moresby commissioned the *Basilisk* in January, 1871, the geographical mantle of his uncle Robert fell upon his shoulders. The work was before him, and he tackled it. He met with discouragement from his immediate superior, and with little support elsewhere. Whatever was done was due to his own initiative, to his own zeal and enthusiasm, which he communicated to his officers, and to his efficiency in conducting very difficult and trying work. In April, 1872, Moresby began the survey of the part of Torres Strait where Owen Stanley's work terminates. He made important discoveries. His main object was to explore the eastern termination of New Guinea, and to discover a good route from Australia to China. In this he succeeded fully and completely, and the chapters which describe this important and, at the same time, very difficult service are most interesting.

During the latter part of the *Basilisk's* exploring work Moresby had a very different superior in the person of Commodore Goodenough, who took a deep interest in it, and officially expressed warm approval. "You have fairly won the civil C.B.," he wrote, and if it had rested with him Moresby's services would have received recognition. Outside the arctic and antarctic circles, this discovery of the eastern

termination of New Guinea, with its off-lying islands, is the most important since the days of Cook. Moresby received no recognition whatever. Port Moresby is, nevertheless, the capital of the new colony of New Guinea since 1884. That fact is a permanent recognition.

In 1878 four charts were discovered at Simancas having reference to the voyage of Luis Vaez de Torres, and one of them covered a small portion of the *Basilisk* discoveries. This does not detract in the slightest degree from the merit of Moresby and his officers. Torres failed where Moresby succeeded. He says, in his letter of July 12, 1607, "I could not weather the east point of New Guinea, so I coasted along to the westward on the south side." This is exactly what Moresby could do, and did, thus making the great discovery which Torres failed to make. The coloured chart was sent to Spain, from Goa, in 1614, by Diego de Prado y Tobar, one of the pilots in the ship of Torres. It is signed by Tobar, but the survey was no doubt made by Torres himself in a boat. Tobar may have been the draughtsman. A legend accompanies the chart, but Admiral Moresby has unfortunately only given a portion of it in his book. The previous part is important. There are twenty-one names on the Torres chart, and of these Admiral Moresby has identified nine. These identifications are certainly correct, and prove that the discoveries of Torres were confined to the Moresby, Basilisk, and Hayter islands of Moresby with Jenkin's bay, and did not include Milne bay and the northern coast.

I am glad to take this public opportunity of expressing my regret that I did not allude to the *Basilisk's* discoveries in my chapter on voyages and discoveries in Clowes's 'History of the Royal Navy.' I repeat that it was a serious oversight. But there is an appreciative notice of the work of the *Basilisk* in my paper on the progress of discovery in New Guinea, which was read at a meeting of the Society in February, 1884. C. R. M.

THE MONTHLY RECORD.

EUROPE.

Norwegian Landscape.—In the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1909, No. 2, Prof. K. Martin describes a journey to Norway mainly from a geological standpoint. The paper is illustrated with some excellent drawings of Norwegian glaciers and the polishing action of ice upon rocks. So far as can be seen, the whole region of the North Fjord and the west coast of Norway is of Archæan formation. The so-called Romsdal-gneiss takes a considerable share in the superstructure of the mountains; it is especially well seen on the road leading from Loen to Visnes, and on the northern shores of the fjords, where dark grey and light varieties frequently occur together. Eye-gneiss is also abundant, and is conspicuous on the path leading up to the summit of the Skaala in the region of Briksdal and near Olden. Immediately opposite Loen the eye-gneiss is disclosed in vast masses and gradually replaces grey gneiss. Mica-schist also occurs, and beneath the material of the moraines granular and slaty amphibolite. The entire mountain system is highly folded, as is easily observed along the fjords and in the stone used for wayside houses near Vasenden and numerous other places. The impressive mass of the Ravnefjeld as seen from Bödals-Saeter is pierced by two systems of deep clefts. The fresh cleavage-planes upon the mountain-sides are easily discernible. The botany of the region is interesting. At the margin of the numerous glacier rills in the valley at Bödals-Saeter alder bushes grow, and at the foot of the neighbouring heights, on peaty soil, heath and whortleberry. Then there are different kinds of Lycopodium—one of them, through its large inflorescence, being

called a geranium—Aconite, "Molte," Seven-stars (*Trientalis europæa*); and among other things Swedish cornel (*Cornus Suecica*), which is also met with in certain places in North Germany. But whereas this plant requires a shady place in Germany, it grows at Bödals-Saeter and other places of the North Fjord unprotected. In the immediate neighbourhood of glaciers the flora changes, and one finds among moraine-gravels the white and purple flowering *Ranunculus glacialis*, L., and the yellow to reddish-yellow *Saxifraga aizoides*, L., especially abundant. Among the brushwood of the hills the ptarmigan is frequently met with. The gneisses which gently slope upwards from the valley at Bödals-Saeter are either rounded by glacier grinding or in consequence of deep inter-locking broken-in steep walls, where the ice-masses of the glaciers terminate. The Saeter and Heistein glaciers show beautiful blue cleavage surfaces, and their margin is seen against the sky in jagged lines of ice-needles. The Bödals glacier appears quite blue from certain points, and the deep blue of the sky appears through its clefts; stretching far away from the heights lie great snow and ice fields. In the neighbourhood of Briksdal (Brix-dal or Brigs-dal) interrupted terraces, formed of the sand and gravel of the mountains by water-action, occur on the mountain slopes.

ASIA.

Dr. Longstaff's Himalayan Expedition.—In a letter lately received, giving some account of the exploration of the Bilaphond (Saltoro) glacier and pass, Dr. T. G. Longstaff says, "Our discovery is that the glacier across the Saltoro pass is enormous, and flows south-east, and *not* north-west as shown on the latest map. No European had previously seen this glacier, and no native has crossed the pass for a century." The party numbered twenty-five, and was away from the base camp a week. The height of the pass is about 18,700 feet. The passage appears to have been very arduous; the rope was in constant use, and much difficulty found with the big crevasses, often concealed, seracs, and the very unsatisfactory form of the moraines. Avalanches were frequent. Meteorological conditions unfavourable to plane-tabling. A telegram has since been received from Dr. Longstaff, dated July 26, to the effect that he had succeeded in finding a way over the mountains into the Shayok valley, and had arrived at Panamik (Nubra).

The Duke of the Abruzzi's Expedition to the Himalayas.—The Duke of the Abruzzi, who set out early in the summer on a mountaineering expedition to the north-west Himalayas, has returned to Bandipur after effecting the ascent, to an altitude of 24,600 feet, of Mount Godwin Austin (or K_2), which contests with Kinchinjanga the honour of being the summit next in altitude to Mount Everest (cf. *Journal*, vol. **31**, p. 103). The mountain is situated in a remote and imperfectly surveyed district, and to the difficulties of the ascent must be added those of the approach to its foot, and the duke's achievement is therefore a meritorious one. An ascent to the height named constitutes a record in mountaineering, the highest point previously reached, the summit of Kabru, being reckoned as 24,015 feet. K_2 had been previously ascended to about 22,000 by MM. Guillarmod and Wessely in 1902 (cf. *Journal*, vol. **24**, p. 211). According to later information, it was not K_2, but a neighbouring peak which the Duke of the Abruzzi ascended.

Indian Geodetic Operations.—The Report of the Board of Scientific Advice for India for 1907–08 contains some particulars respecting geodetic operations during the year under review. With a view to institute more precise linear measurements in India, so as to keep pace with the improvements effected in other countries, Captain H. H. Turner, R.E., has been making inquiries in England respecting the latest methods of base measurement. In the United States, base-lines are being measured every 100 miles, and in South Africa at intervals of

120 miles. In India proper there have been sufficient base-line measurements, but throughout the whole of the Burma triangulation there is not a single base-line. During the last few years the Indian triangulation has been extended to the west through Baluchistan up to the Persian border, and here again no bases have been measured. In accordance with Captain Turner's recommendation, "Invar" wires, of the type manufactured in Paris and tested by the Bureau International des Poids et Mesures at Sèvres, have been obtained for the purpose of measurement in 24-metre lengths, and the unit of measurement for geodetic surveys in India has been altered from the foot to the metre. In 1907–08 three detachments were employed upon principal triangulation, and thus a larger addition than usual has been made to the Geodetic Survey of India. In Western Baluchistan Captain Browne completed the Kalat Longitudinal Series up to the Persian border. This series has taken four years to complete, and the triangles extend for a total distance of about 480 miles from its origin on the Indus, and cover an area of 11,000 square miles. Comparing the accuracy of this survey, through means of its probable error, with some recent surveys of other countries, it is satisfactory to observe that in the Kalat series the probable error of an observed angle was 0″·21; while in the recent triangulation of Rhodesia it was 0″·44, in that of Cape Colony, 0″·34, and in that on the 98th meridian of the United States, 0″·48. When one considers the great difficulties of carrying triangulation through uninhabited and waterless deserts like those of Baluchistan, we can realize the care, accuracy, and perseverance that have been necessary to obtain results superior to those of Africa and America. Koh-i-Malik Siah, the westernmost station of the Kalat series and tri-junction point of India, Persia, and Afghanistan, was found to be out of position to the extent of 468 feet. Koh-i-Taftan, another interesting mountain and conspicuous landmark, 12,935 feet in height (cf. February number, p. 212), was also fixed. Here again the position was found to be materially (600 feet) out of its true place. In Burma the great Salwin triangulation was restarted from the point at which it had been discontinued in 1902–03; its direction has now been made to follow the British boundary, so that it may encompass as much as possible of British territory. The country through which the Salwin series runs is wooded and mountainous, the stations being generally at an elevation of 7000 feet. By this extension into Eastern Burma, combined with that into Western Baluchistan, the length of the Indian arc of parallel has been increased to 38° of longitude. In Northern Baluchistan, triangulation is being extended from Kalat through Toba and Zhob along the Afghan boundary, and will eventually join the great Indus series at Sheikh Budin. It is hoped that, with two observers working simultaneously, this series may be finished in 1909–10.

The Death of Mr. J. W. Brooke in Western China.—A detailed account of the circumstances under which the enterprising traveller, Mr. J. W. Brooke, met his death, has been received from Mr. C. H. Meares, his travelling companion, who, it will be remembered, remained at Ning-yuan-fu while Mr. Brooke made what was intended as a preliminary trip into the Lolo country. It differs in some respects from the accounts previously published, on which our former note (*Journal*, vol. 33, p. 597) was based. The final account has been obtained by careful enquiries, and is vouched for by the independent statements of two of the deceased traveller's coolies, who, after being sold as slaves, have since been ransomed and have been interviewed by Mr. Meares. From Ning-yuan-fu Mr. Brooke seems to have gone north-east to Chao-chou, where he made friends with a Lolo chief, who sent his son to introduce him to the next chief. Being passed on thus from chief to chief, and meeting everywhere with a friendly reception, he travelled five days north-east from Chao-chou and reached the pass over the great range, where the party camped in

the snow, and could see the position of Ma-pien, and Mount Omi in the distance. During the night the escort deserted, but Mr. Brooke started on the return journey, intending to come out on the main road three days north of Ning-yuan-fu. At the first Lolo village the wife of the chief (who was himself away) refused to act as escort unless paid in advance, so Mr. Brooke went on without one. The chief of another village at first agreed to act as escort, but afterwards sent two of his slaves instead. At a house belonging to the Ah-heo tribe, where the party slept, some articles were stolen, and no present was therefore given. During the next day's march, at a point where the path entered a gorge, Mr. Brooke was overtaken by an armed party of the same tribe; but terms had been arranged after some discussion, when, Mr. Brooke putting his hand in a friendly way on the chief's shoulder, the latter made a fierce cut at his head with his sword, wounding him in the arm. Mr. Brooke then shot the chief dead with his revolver, firing a few more shots which put the rest to flight. The traveller and his men rushed through the gorge and across a river to the house of a chief named Suga, who offered an escort in return for Mr. Brooke's rifle, which was given up. Hundreds of Lolos then surrounded the house, in which Mr. Brooke tried to defend himself and his men; but, his cartridges being soon expended, the Lolos climbed the roof and knocked him insensible with a large stone. They then rushed the house and killed him and his men, with the exception of the two above mentioned, one of whom had been caught before they reached the house. Mr. Meares reports that Mr. Brooke's body had at last been recovered, and was to be buried at Cheng-tu.

Disaster to a German Expedition in Western Yunnan.—We mentioned (*Journal*, vol. **32**, p. 529) the departure of a German traveller, Dr. Brunhuber, on an expedition to the region of the upper Salwin. According to reports lately received from China, the expedition met with disaster in March of this year, both Dr. Brunhuber and his companion, Dr. Schmitz, being murdered by one of the primitive tribes of that region, who are only nominally subject to the Chinese authorities. Full particulars are not yet to hand, but the scene of the murder is said to have been a village on the Nu-kiang, or upper Salwin. It will be remembered that this region, or a part of it, was successfully traversed by Messrs. Litton and Forrest in 1905, and that an account of the journey appeared in the *Journal* for September, 1908.

AFRICA.

M. Chevalier's Expedition in West Africa.—As announced in the *Journal* for March last, M. Chevalier set out at the end of 1908 on a new expedition in French West Africa, intending to make his way through French Guinea to the Hinterland of the Ivory Coast. News of the expedition have been received in France from time to time, bringing the account of his proceedings down to the beginning of May, when, after passing successfully behind the interior frontier of Liberia, he had reached the region of the upper Cavalla. Some of the most important results of the journey are briefly summarized in a communication printed in the July number of *La Géographie*. Especial attention had been devoted to the economic botany of the region, the occurrence of the various rubber-producing trees and plants being carefully noted. During the first part of the route the true rubber tree, *Funtumia elastica*, found throughout the great forest of the Ivory Coast, was not seen, the species met with being *Clitandra orientalis*, not previously found in West Africa, and *Landolphia owariensis*. A good part of the route lay along the watershed between the Niger and the southward-flowing rivers, the sources of several of which, *e.g.* the Makona, St. Paul, and Sassandra, were determined. About Bela, an important centre marked on the maps just south of 9° N., the forest has been entirely

destroyed, and the resulting bare expanse is quite useless for agriculture, though it would be well adapted for stock-rearing. European traders have established themselves here, and bars of salt are imported from Europe as an article of barter, quite cutting out the salt formerly brought from Timbuktu. Hence the journey was continued, without escort, towards the forest of the Ivory Coast, the country having been completely tranquillized. One of the tribes encountered was that of the Gerzes, who seem to have no connection with any other tribe of this region. They had previously been studied by Dr. Frobenius (*Journal*, vol. 33, p. 721). In their country are the most important markets for kola-nuts in this region. Hence the expedition explored the Naba mountains, which seem to be the highest in all French West Africa. They have nearly perpendicular sides, and one of the party, who reached the summit with great difficulty, determined the altitude to be 1646 metres (5400 feet). Unlike the usual gneiss or granite *massifs*, these mountains seem to be due to elevation, being composed of reddish-brown schists. They give rise both to the Diugu or Cavalla and to the Nuon, now said to be the upper course of one of the Liberian rivers.* The northern versant of the range is inhabited by an exceedingly primitive cannibal tribe, that of the Dans or Diolas.

Proposed Journey from the Niger to the Nile.—Dr. Karl Kumm, of the Sudan United Mission, who is a Fellow of our Society and has devoted much attention to a study of the geography of the Sudan, was, on April 13 last, proceeding up the Shari with a view to making his way by its tributary, the Aukadebbi, to Hofrat-en-Nahas, on the borders of Darfur, and thence by the Bahr-el-Arab to the Nile. This route would lead through some of the least-known ground in this part of Africa, and Dr. Kumm should, if successful in his attempt, bring home some valuable information on the country along his route. A few years ago Dr. Kumm wrote, as dissertation for the degree of doctor at a German university, a valuable summary of our knowledge of Sudanese geography, and he is therefore fully conversant with the work of his predecessors.

Navigation of the Niger and Benue.—The latest Colonial Report on Northern Nigeria (Annual No. 594) deals, *inter alia*, with the question of improving the navigation of the lower Niger and Benue rivers, a question which has only lately been seriously approached, but in regard to which the governor, Sir Percy Girouard (who has just been transferred to British East Africa), is sanguine of success from the measures which have now been set on foot. The great range in level between high and low water has hitherto prevented the continuous use of the rivers for navigation by vessels drawing more than from 1 foot 6 inches to 3 feet of water. In the dry months the obstructions are mainly in the form of sand-bars, which begin to form on the fall of the water in December. In 1907 a survey of these bars was carried out, and it was found that the amount of obstruction had been greatly exaggerated; the actual bars, some fifteen in number, presenting total obstruction of not more than 3 or 4 miles in a distance of 400 miles. It is hoped that the use of suction dredgers, which have proved so efficient on the Mississippi, may do much to improve the existing state of things, and one had already, at the date of the report, been ordered for the purpose. Whereas on the Mississippi a 9-foot channel has to be kept clear, and this on a river subject to constant fluctuations of level, it is considered sufficient to aim at keeping open a 4-foot channel, as this would admit the passage of the largest stern-wheelers now on the rivers. It is hoped to maintain such a channel as high as Baro, 60 miles above the Benue junction, and the starting-point of the railway under construction to Kano; the greatest difficulties occurring in this

* M. Chevalier says the Cestos, though, according to a recent traveller in Liberia (*Journal*, vol. 31, p. 106), it is the St. John.

section, where the river is not swelled by the contribution of the Benue. Some interesting information is given on the existing Government transport arrangements on the two rivers.

Railway Construction in Nigeria.—A recently issued Blue Book presents the official correspondence on this subject, from June 26, 1906, to February 19, 1909, accompanied by three sketch-maps. The works thereby sanctioned include the construction of a mole on the east side of the entrance to Lagos harbour; preliminary works and plant for a projected western mole; the laying of a pioneer railway, 400 miles long, from Baro, the highest point in the permanently navigable reaches of the Niger, to Kano, *viâ* Bida, Zungeru, and Zaria; the extension of the Lagos railway from Ilorin, *viâ* Jebba on the mid-Niger, to join the Baro railway at Zungeru (from Ilorin to Jebba to be of the same type as the rest of the line from Lagos, but from Jebba of the "pioneer" type), as well as the construction of a railway bridge at Jebba. On February 17, 1909, the rail of the Baro-Kano line reached its 50th mile. Opened to Ibadan on March 4, 1901, the Lagos railway, thence running easterly, was opened to Iwo (30 miles) on October 23, 1904; to Oshogbo on April 22, 1907; to Ikerun on March 1, 1908; to Ilorin (123 miles from Ibandan and 246 from Lagos) on August 27, 1908. Ten miles beyond Ikerun the Northern Nigeria boundary was crossed, and 96 miles beyond Ibadan, at the town of Offer, the summit of the watershed between the sea and the Niger. The rails were expected to reach Jebba last January, thus establishing direct communication between the sea and the middle Niger. Interspersed in the correspondence are some more directly geographical items. The stretch between Ibadan and Jebba is reported to be the most populated part of the whole route between Ibadan and Kano, and to be well settled and peaceful. The whole country, on the other hand, from Ilorin to Jebba and from Jebba to Zungeru is thinly populated; yet the villages, though small, are at fairly frequent intervals, and the whole country appears to be fertile, and, where cultivated, the farm products grow well. There is a detailed report of the country between Jebba and Barijuko on the Kaduna river. In the course of a tour through Northern Nigeria, January to April, 1907, no trading station was found for a stretch of 200 miles below the French boundary between Ilo and Liaba.

Earth-movements at Lake Victoria.—We have alluded (vol. **33**, p. 328) to some notes by Captain Lyons, in the *Cairo Scientific Journal*, on possible recent Earth-movements indicated by the readings of the gauges on Lake Victoria. In a subsequent number (April, 1909) of the same journal Mr. J. I. Craig expresses a doubt as to the correctness of Captain Lyons' conclusions, at least as regards the indications of the readings in 1908. He points out that a fall in the readings at the Jinja gauge would indicate a rise of the land about Ripon falls, and that this would check the outflow and bring about a general rise in the level of the lake, of which the readings at the other gauges give no sign. He is inclined to doubt the correctness of the 1908 records at Jinja.

The Geodetic Survey of South Africa.—The report of H.M. astronomer at the Cape for 1908 contains, as usual, a brief reference to the operations of the Geodetic Survey of South Africa. As a result of the standardization of the Russian $2\frac{1}{2}$-metre bar used in the measurement of the Loangwa valley base, a definite reduction of the length of the latter has been made. The length as measured corresponds so closely with that computed through the triangulation (itself dependent on bases measured in Southern Rhodesia), that no readjustment of the triangulation has been deemed necessary. The definitive co-ordinates of all stations occupied in Rhodesia have been computed, and the preparation of the final report only awaits the discussion of the places of the stars used in latitude observations. The telegraphic

determination of the longitude of Ascension, also referred to in the report, was dealt with in the *Journal* for June last (p. 723).

AMERICA.

The Forty-ninth Parallel as the United States and Canada Boundary.—The difficulties in the way of laying down on the ground a frontier formed by a mathematical line like a parallel of latitude are not generally realized by non-experts. They are very clearly explained in a paper, by Dr. O. Klotz, which originally appeared in the *Journal of the Royal Astronomical Society of Canada* (November—December, 1908), and has also been issued as a reprint. As is well known, the boundary between Canada and the United States was, by agreements arrived at in 1818 and 1846, fixed as the 49th parallel from a point near the Lake of the Woods to the middle of the channel separating Vancouver island from the mainland. The two sections, east and west of the Rocky mountains, were surveyed and marked with more or less precision by international commissions in 1872–74 and in 1857–61 respectively, while the survey of the more difficult western section has lately been completed by another commission. Dr. Klotz points out how the deflection of the plumb-line, due to accidents in the form and composition of the Earth's crust, interferes with the determination of a parallel of latitude, causing the line as fixed by astronomical observations to be deflected in one direction or the other from its theoretic position. It is found that points astronomically determined in latitude cannot be connected by lines projected as sections of a parallel from one station to the next. The mean parallel may be obtained by making the sum of the discrepancies north equal to the sum of those south; but its determination is a matter of difficulty, and the astronomical, not the mean, parallel is therefore usually adopted in such cases. This was done in the case of the 49th parallel, with the sole exception of a stretch of 71 miles in the western section (lying between the Similkameen and Columbia rivers), where, for special reasons, the mean parallel was adopted. For the rest, the line forms an irregular curve with deflections to the north and south of the mean parallel. The reasons for these are made clear by a diagram, in which the course of the line (with deflections greatly exaggerated) is shown side by side with a sketch of the topography. Thus the greatest discrepancy (amounting to 1407 feet) occurs in a section of $97\frac{7}{10}$ miles between the Cypress hills, to the north of the boundary, and the Three Buttes, mainly to the south; these features having pulled the astronomical parallel, the one 602 feet north, the other 805 feet south, of the mean parallel. As regards the lines joining adjacent stations, the same principle was not followed throughout. Whereas in the eastern section it was agreed that they should be arcs of the parallel, in the west they were understood to be straight lines, or arcs of great circles. The British Columbia frontier, therefore, deviates to this extent from the 49th parallel adopted by the treaty, the maximum departure being, however, only 40 yards in the case of a chord 25 miles in length. The boundary in question (1270 miles) is the longest astronomic one on the Earth, the nearest approach to it being the meridian bounding Western Australia to the east.

Origin of the Great Basin Ranges.—In a paper by Mr. Charles R. Keyes, published in the *Journal of Geology*, January—February, 1909, it is suggested that wind-erosion has had much to do with the origin of the great Basin ranges in the desert country of western and south-western North America. To the larger relief features of the western desert region a purely tectonic origin cannot be assigned; they are also inexplicable on any system of water-erosion. The vastness and evenness of the desert plains, the singular isolation of the desert ranges, the entire absence of foothills, the thinness of the surface mantle of *débris*, the absence of district waterways on the plains, not to mention other characteristics, all point to

wind-scouring force as instrumental in the moulding of the landscape in these arid regions. The same may be said of South Africa, where the great elevated plateau of the dry region has been long relatively free of orogenic movement, and where there are the same isolated mountains, the same vast and even inter-mont plains, and the same lack of streams. Mr. Keyes is of opinion that under conditions of aridity wind-scour is more potent than all other agencies combined.

AUSTRALASIA AND PACIFIC ISLANDS.

Opening up of South-West Tasmania.—We have received an extract from the latest Report of the Surveyor-General of Tasmania, describing the steps taken during 1908 to open up some of the imperfectly known districts in the south-west part of the island by cutting tracks capable of being used by prospectors and pack-horses, the work having been undertaken in fulfilment of the provisions of the "Exploration Act, 1907." The area in question lies west of the upper valley of the Derwent, and is watered by the various branches of the river flowing into Macquarie harbour on the west coast. It is traversed by several ranges of mountains, the highest points of which reach altitudes of over 4000 feet. Four different parties were sent out, and altogether, besides some 50 miles of old tracks that were cleared out (including that cut in connection with the "Great Western Railway" survey), about 100 miles of new tracks were cleared and marked. Some of these, *e.g.* one cut by Mr. E. B. D. Innes in a south-westerly direction from the Great Western railway track, across the Prince of Wales range, were through virgin ground. The Surveyor-General, Mr. Counsel, who personally inspected some of the country traversed by the parties, says that he was not impressed with its value from an agricultural point of view, though the Rasselas valley (on the upper course of the Gordon river) and the King William plains (upper basin of the Derwent, east of the King William range) might be capable of carrying stock in summer, while some good timber also occurs. The tracks cut are shown on a map which accompanies the report.

The Hamburg Expedition to the Pacific.—Some account of the work already accomplished by this expedition, the organization of which was announced in the *Journal* for July, 1908 (p. 91), is given in *Globus* for July 29 of this year. Its principal field of operations has been the little-known island of New Britain (New Pomerania), the first crossing of which, in its full width, has been effected by the expedition. As mentioned in our previous note, the expedition, which is under the leadership of Dr. Fülleborn, has the benefit of a vessel specially chartered for the purpose, and its work has been greatly facilitated thereby. A preliminary cruise along the north coast of the island showed that the eastern district—that of Nakanai—which has not been supposed to extend further west than Open bay, in reality extends for more than half the length of the north coast, being followed, further west, by those of Talasea and Bariai, in which the influence of New Guinea culture is much more manifest. Owing to the exposure of the north coast to the north-west monsoon during the early months of the year, it was decided to begin serious work on the south coast, which was followed from east to west, a large number of coast villages being visited, and some communication opened with the very primitive dwellers in the back country. The observations permit the definition of several distinct culture regions on this coast. Artificial deformation of the skull was found to be practised, especially between Montague harbour and Cape Pedder. The voyage extended to the New Guinea coast (where a key was found to various facts in the ethnology of western New Britain), and a visit was paid to Sir George Rooke or Umbai island. Returning, a landing was effected at the mouth of the Pulie river, whence a trade route leads across to the north coast, and this was

utilized for the crossing of the island by Dr. Fülleborn and two of his European companions, who afterwards returned by the same route. The crossing occupied seven days, and the country was found to be covered with a uniform thin forest, broken only by the extensive plantations of the natives. The health of several members of the expedition has unfortunately suffered a good deal.

POLAR REGIONS.

Government Grant to Mr. Shackleton.—The Prime Minister announced in the House of Commons on August 19 that the Government had decided to recommend a grant of £20,000 to Mr. Shackleton's Antarctic Expedition on account of its value and importance.

Meteorology of the Greenland Sea.—Mr. R. C. Mossman, well known for his meteorological work in the Antarctic and elsewhere, paid two visits to the Greenland sea in the steam whaler *Scotia*, in 1906 and 1907, with a view to studying the meteorological conditions of the region. He has since made a study of all available information on the same subject collected by others, and has summarized the general results in an interesting paper in the *Scottish Geographical Magazine* for June of this year. The paper is of value as bringing out, from the mass of crude material supplied by his own and previous observations, the salient characteristics of the summer climate of the region in question. A point of particular interest, not properly understood before, is the preponderating influence on the temperature distribution exercised by the outer edge of the ice along the Greenland coast. The remarkable belt of fog which marks the meeting-line of ice and sea is, in fact, the dominating climatic factor, by which the whole industry of whale-fishing is most seriously affected. Even at the height of summer the direct solar influence is very feeble over the Greenland ice-fields, and such is the lowering of temperature effected by the fog and ice that this part of the ocean has for its latitude the lowest mean summer temperature of any oceanic area in the northern hemisphere. Instead of running approximately along parallels of latitude, the summer isotherms are entirely dominated by the longitude of the outer edge of the ice. Mr. Mossman has, with the help of the data published by the Danish Meteorological Institute, worked out the mean position of the edge of the ice from May to August for each degree of latitude from 60° to 80°, and he shows the results graphically in a series of charts. The variation in the position of the ice-edge does not, of course, represent the entire effect of melting, as the whole body of the ice moves south-west at a mean velocity of 10 miles per day, the observed changes being the resultant of the two factors. While the most marked retreat of the ice occurs in Denmark strait, there is a second area of rapid recession in about 77° N.* Mr. Mossman traces the general characteristics of the period April to August, month by month, more detailed data being also given in appendices.

Ice in the Arctic Seas in 1908.—The Year-book for 1908 issued by the Danish Meteorological Institute is illustrated by five maps, showing the distribution of ice over the Arctic at various periods of the year. In contrast with the situation in 1907, Franz Josef Land, Spitsbergen, and the east coast of Greenland, as also Smith sound and the waters to the north of it, were much freer of ice than usual. On the other hand, an excessive ice-drift was maintained towards the Bering and Beaufort seas, which throughout 1908 continued beset with tight pack-ice. In May, the extreme north rim of the Gulf of Bothnia was still blocked with floes. In the White sea the floes, which covered

* The fact that Mr. Mossman's charts are on Mercator's projection somewhat obscures these differences in the rate of retreat.

it in May, were not wholly dissolved till June. The ice-boundary between Greenland and the north of Europe ran, in May, along 0° long. from the north of Jan Mayen to the north-west of Spitsbergen, thence south to about 73°, and thence irregularly northwards, through Barents sea, where it reached 74°, to Novaya Zemlya, where, along the south-west coast to Matochkin Shar, there stretched a narrow belt of pack-ice. The south-east coast of Greenland was mostly clear of ice in May. Yet in May Angmagsalik and the south-west of Greenland lay blocked with pack-ice, and icebergs were closely ranked in Davis strait. In August there was open sea between Norway and Greenland. Angmagsalik, which had been cut off from all communication with the outer world since September, 1906, was not, however, touched till August 20, 1908, when it was reached without difficulty. Yet icebergs still dotted the Greenland coast, thence southwards to Cape Farewell. In August the Beaufort sea between Cape Lisborne and Point Barrow still lay fast in firm pack-ice. By the end of July ships sailed unimpeded to the south-east side of Franz Josef Land.

GENERAL.

The Return Voyage of the "Nimrod."—On leaving the *Nimrod*, to return to this country by the direct route, Mr. Shackleton arranged that the homeward voyage of the ship should be made by a route which would permit the accomplishment of a further useful piece of geographical work. This was the search for several small islets or groups of islets, supposed, on somewhat doubtful authority, to exist in the southern ocean between Australia and South America, and tentatively inserted on the charts. The *Nimrod* left Sydney on May 8, under the command of Captain J. K. Davis, and on May 18, passed over the position assigned to the Royal Society islands (? Royal Company islands, south of Tasmania), but though the weather was clear, no land was sighted. A sounding gave a depth of 2430 fathoms. Captain Davis stood east and then south, and being persuaded that no land existed in the vicinity, proceeded to Macquarie island. This was found to be inhabited by a solitary individual, who had elected to remain on the departure of a party which had visited the island the year before in quest of seal and penguin oil. The ship next reached (May 31) the supposed position of Emerald island (south-south-east of Macquarie island), which was passed over at night with a bright moon shining and no sign of land. A heavy sea made it impossible to take soundings. Equally vain was the search for the Nimrod islands, the charted position of which (56° S., 159° W.) was reached on June 9, in clear weather. After dark, an attempt was made to sound by lamp-light, the ship rolling heavily. No bottom was found with 1140 fathoms, fierce squalls then making it necessary to desist. The last of the reported islands searched for was Dougherty island (59° S., 119° W.), but only floating ice was seen, and Captain Davis thinks that the report of land in this position had no better foundation than an iceberg. The *Nimrod* then proceeded to Montevideo *en route* for England.

Dr. Supan.—The distinguished German geographer, Dr. Supan, for a number of years editor of *Petermanns Mitteilungen*, has been called to the chair of geography at Breslau University. This has necessitated his giving up the editorship-in-chief of the *Mitteilungen* to Dr. Paul Langhans, whose cartographical and other contributions to geography are well known, and who will still have the co-operation of Prof. Supan in the task he has undertaken. Prof. Supan has been appointed the representative for Silesia on the Zentralkommission für Wissenschaftliche Landeskunde von Deutschland.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full :—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps. *B. American G.S.* **41** (1909): 65–71. **Penck.**

The Origin of the Alps. By Albrecht Penck.

Alps—Glaciers. *Jb. Schweizer Alpenclub* **43** (1907): 302–331. **Forel and others.**

Les variations périodiques des glaciers des Alpes suisses. 28e rapport, 1907. Par Dr. F. A. Forel, E. Muret, Dr. P. L. Mercanton, et E. Argand.

Alps—Mont Blanc. *Alpine J.* **24** (1909): 419–423. **Bourrit.**

A letter from M. T. Bourrit to H. B. de Saussure. (Published by Henry T. Montagnier.)

The letter describes Bourrit's attempt to ascend Mont Blanc, made in 1783.

Alps—Simplon. *B.S.G. de l'Est* **29** (1908): 256–286. **Lebrun.**

Les Voies d'accès au Simplon. Par M. Lebrun. *Map.*

Alps—Simplon. *B.S.G. Lille* **51** (1909): 266–303. **Plichon.**

Le tunnel du Simplon. Par J. Chichon. *Maps.*

Alps—Southern. *Jb. Schweizer Alpenclub* **43** (1907): 209–231. **Walder.**

Bergwanderungen an der französisch-italienischen Grenze mit Betrachtungen über den Hannibalweg. Von Dr. E. Walder.

Alps—Structure. *Petermanns M.* **54** (1908): 219–228, 248–258, 267–283. **Frech.**

Ueber den Gebirgsbau der Alpen. Von Prof. Dr. Fritz Frech. *Map, Sections, and Illustrations.*

Austria—Croatia. *M. k.k. G. Ges. Wien* **51** (1908): 471–488. **Gessmann.**

Ein Ausflug zu den Plitvicer Seen in Kroatien. Von Gustav. W. Gessmann. *Illustrations.*

Austria—Karst. *M. k.k. G. Ges. Wien* **51** (1908): 453–462. **Perks.**

Die Tropfsteinhöhle von Slivno bei Nabresina (Triester Karst). Von G. Andreas Perks. *Plan and Section.*

Balkan Peninsula—Geology. **Cvijić.**

Abh. k.k. G. Ges. Wien **7** (1908): No. 3, pp. iv. and 56.

Das pliozäne Flusstal im Süden des Balkans. Von Dr. J. Cvijić. *Map and Sections.*

Balkan States—Bibliography. **Yovanovitch.**

An English bibliography on the Near Eastern question, 1481–1906. By Voyslav M. Yovanovitch. (Servian Royal Academy, Second Series of Monuments, part 48.) Belgrade, 1909. Size 13 × 9½, pp. 112. *Presented by the Author.*

Belgium—Antwerp.

Belgium. Report for the year 1908 on the Shipping and Navigation of the Port of Antwerp. Dipl. and Cons. Reports, Annual Ser., No. 4182. Size 9½ × 6, pp. 39. *Map. Price* 6½*d.*

Carpathians. *M. k.k. G. Ges. Wien* **51** (1908): 463–470. **Czirbusz.**

Die geographische Physiognomik in der Namenkunde. Ein Beitrag zur Namenkunde der Karpathen. Von Prof. Dr. Géza Czirbusz.

Central Europe—Hydrology. **Keller.**

Niederschlag, Abfluss und Verdunstung in Mitteleuropa. Von H. Keller. (Jahrbuch für die Gewässerkunde Norddeutschlands. Besondere Mitteilungen, Bd. I., Nr. 4.) Berlin, 1906. Size 13 × 9½, pp. 44. *Diagrams.*

Denmark—Copenhagen. *Aarbøger Nordisk Oldkyndighed* **23** (1908): 37–76. **Lundbye.**

Det aeldste Kjøbenhavn. Af Peter Lundbye.

France—Divisions. **Gaffarel.**

Congrès Alliance française et S.G., Marseille (1906–1908): 184–202.

Des réformes à introduire dans la géographie administrative de la France. Par Paul Gaffarel.

France—Hérault. *B.I. Océanog. Monaco*, No. 132 (1909): pp. 17. **Chevallier and Sudry.**

La source de la Bise dans l'Etang de Thau. Par Chevallier et Sudry. *Illustration, Plan, and Sections.*

France—Irrigation. **Montricher.**

Congrès, Alliance française et S.G., Marseille, 1906 (1908): 214–221.

La Provence et ses irrigations. Par Henri de Montricher.

France—Loire. **Monmarché.**

Joanne Guide-books. English Series. The chateaux of the Loire. By Marcel Monmarché. London: Hachette & Co., 1909. Size 6½ × 4, pp. viii. and 134. *Maps and Illustrations. Presented by the Publishers.*

France—Rainfall. *B.S.G. de L'est* **29** (1908): 245–255. **Millot.**

La Pluie à Nancy, de 1878 à 1907 (30 années). Par C. Millot.

United Kingdom—Scotland. **Schoener.**

Schottland. Von J. Eg. Schoener. Ein geographisches Charakterbild. (From *Zeitschrift für Schul-Geographie*, 30 Jahrg., vi. Heft.) [Vienna, 1909.] Size 9 × 5½, pp. 166–178. *Presented by the Author.*

United Kingdom—Scotland. *B. American G.S.* **40** (1908): 739–744. **Tarr.**

The Scottish Highlands. By Ralph S. Tarr.

United Kingdom—Scotland. *P.R.S. Edinburgh* **29** (1909): 98–135. **Wedderburn.**

Temperature Observations in Loch Garry (Inverness-shire), with notes on Currents and Seiches. By E. M. Wedderburn. Size 10 × 7. *Also separate copy. Diagrams.*

United Kingdom—Seismology. *Beiträge Geophysik* **9** (1908): 441–504. **Davison.**

On the British earthquakes of the years 1901–1907. By Dr. Charles Davison. *Sketch-maps and Diagrams.*

United Kingdom—Thames Valley. **Jukes-Brown and White.**

Memoirs of the Geological Survey: England and Wales. Explanation of Sheet 193. The Geology of the Country around Henley-on-Thames and Wallingford. By A. J. Jukes-Brown and H. J. Osborne White. London, 1908. Size 9½ × 6, pp. viii. and 114. *Sketch-map and Sections. Price 2s. 0d.*

United Kingdom—Yorkshire. *P. Yorkshire Geol. S.* **16** (1908): 372–382. **Elgee.**

The glaciation of North Cleveland. By Frank Elgee. *Maps.*

United Kingdom—Yorkshire. **Fox-Strangways.**

Memoirs of the Geological Survey: England and Wales. Explanation of Sheet 62 (93 N.W. old series). The Geology of the Country north and east of Harrogate. By C. Fox-Strangways. Second edition. London: Wyman & Sons, 1908. Size 9½ × 6, pp. vi. and 100. *Map, Sections, and Illustrations. Price 2s. 6d.*

United Kingdom—Yorkshire. *P. Yorkshire Geol. S.* **16** (1908): 383–390. **Gilligan.**
Some effects of the storm of June 3, 1908, on Barden Fell. By Albert Gilligan. *Sketch-map and Illustrations.*
Gives a vivid idea of the erosive power of water (see July number, p. 84).

United Kingdom—Yorkshire. *P. Yorkshire Geol. S.* **16** (1908): 253–320. **Hughes.**
Ingleborough. Part vi.: The carboniferous rocks. By T. McKenny Hughes. *Sketch-map, Sections, and Illustrations.*

United Kingdom—Yorkshire. *P. Yorkshire Geol. S.* **16** (1908): 347–371. **Wilmore.**
Notes on the geology of Thornton, Marton, and Broughton-in-Craven. By A. Wilmore. *Sketch-map, Illustrations, and Sections.*

ASIA.

Ceylon. *J. Ceylon Branch R. Asiatic S.* **21** (1909): 165–185. **Lewis.**
The lesser-known hills of the Batticaloa district and Lower Uva. By F. Lewis.

Ceylon—Historical. **Ferguson.**
The history of Ceylon, from the earliest times to 1600 A.D., as related by João de Barros and Diogo do Couto. Translated and edited by Donald Ferguson. (From the *Journal of the Royal Asiatic Society*, Ceylon Branch, vol. **20**, 1908.) Colombo, 1909. Size 8½ × 5½, pp. 446.

China—Central. *B. Com. Asie Française* **9** (1909): 8–11. **Noiret.**
La conférence du Lieut. Noiret [sur la mission de M. Bons d'Anty au Hou-nan et au Kouei-tcheou, en 1907]. *Sketch-map.*

China—Hainan. *B. Comité Asie Française* **9** (1909): 94–101. **Madrolle.**
Conférence de M. Cl. Madrolle sur l'île du Haïnan. *Map.*
See note in the June number.

China—Lolos. *T'oung Pao*, Ser. II. **9** (1908): 529–576. **Madrolle.**
Quelques peuplades Lo-Lo. Par Cl. Madrolle. *Sketch-map.*

China—Yunnan. *T'oung Pao*, Ser. II. **9** (1908): 663–688. **Cordier.**
Les Mo-sos. Par Henri Cordier. *Illustrations.*
A summary of existing knowledge respecting this aboriginal tribe.

China—Yunnan. **Soulié, and Yi-Tch'ou.**
B. Ecole française Extreme-Orient **8** (1908): 149–176, 333–379.
Les Barbares soumis du Yunnan. Par G. Soulié et Tchang Yi-Tch'ou. *Map.*
Translation of a chapter from a Chinese original, known as the *Tien-hi.*

Chinese Empire—Tibet. *Z. Ges. E. Berlin* (1909): 155–160. **Hedin.**
Entdeckungen in Tibet. Von Dr. Sven von Hedin.

India. **Ali Khan.**
'India of To-day.' By Syed Sirdar Ali Khan. Bombay, 1908. Size 9½ × 5½, pp. v. and 132. *Presented by the Author.*

India. ——
Annual Report of the Board of Scientific Advice for India for the year 1907–08. Calcutta, 1909. Size 10½ × 7, pp. vi., 192, and xiv. *Map.*

India—Baluchistan and Sind. *Records Geol. Surv. India* **37** (1908): 139–166. **Pilgrim.**
The Tertiary and Post-Tertiary Freshwater Deposits of Baluchistan and Sind, with notices of new Vertebrates. By Guy E. Pilgrim. *Illustrations.*

India—Bombay. *Records Geol. Surv. India* **37** (1909): 167–190. **Bose.**
Notes on the Geology and Mineral Resources of the Rájpiplá State. By P. N. Bose. *Map and Illustration.*
Rajpipla lies to the south of the Lower Narbada.

India—Burma—Mergui. *Travel and Exploration* **1** (1909): 284–290. **Brown.**
The Mergui Archipelago. By R. N. Rudmose Brown. *Illustrations and Sketch-map.*

Japan—Hokkaido. ——
Japan. Report on the Mining Industry in the Hokkaido. Dipl. and Cons. Reports, Misc. Ser., No. 676. 1909. Size 9½ × 6, pp. 18. *Price* 3*d.*

Japan—Oshima. *J. Tokyo G.S.* **20** (1908): 682–690, 786–799. **Nakamura.**
The Volcano of Oshima, its Past and Present. By Seiji Nakamura. *Sketch-plan.*

Malay Archipelago—Borneo. *B.S.G. Italiana* **10** (1909): 511–539. **Bonarelli.**
Trenta mesi a Borneo. Dal Prof. Guido Bonarelli. *Maps.*

Malay Archipelago—Sumatra. *G.Z.* **15** (1909): 1–12. **Volz.**
Die geomorphologische Stellung Sumatras. Von Wilhelm Volz. *Maps and Sections.*

Philippine Islands. *Philippine J. Sci.* **3** (1908): 385–442. **Merrill.**
On a Collection of Plants from the Batanes and Babuyanes Islands. By Elmer D. Merrill. *Map.*
The collection shows the strong affinity of the flora to that of the Philippines in general, and its slight relationship to that of Formosa.

Philippine Islands—Luzon. *Philippine J. Sci.* **3** (1908): 197–214. **Cole.**
The Tinggian. By Fay Cooper Cole. *Illustrations.*
This people inhabits the north-west of Luzon.

Philippine Islands—Luzon. *B.S. Belge d'Etudes Col.* **16** (1909): 203–220. **Dierickx.**
La province de Benguet. (Ile de Luçon) Par le R. P. P. Dierickx.

Philippines—Mindanao. *Philippine J. Sc.* **3** (1908): 501–510. **Goodman.**
A Reconnaissance from Davao, Mindanao, over the Divide of the Salug river to Batuan, including a Survey from Davao to Mati. Narrative of the Expedition. By Maurice Goodman. *Sketch-maps.*

Philippines—Rainfall. *Deutsche Rundschau G.* **30** (1908): 529–539. **Krebs.**
Die Niederschlagsverhältnisse der Philippinen. Von Wilhelm Krebs. *Map and Illustrations.*

Russia—Caucasus. *Mém. Comité Géol., N. Ser. Livr.* **28** (1908): pp. 40. **Golubyatnikoff.**
Die Insel Swjatoi (Gouvernement Baku). Von D. Golubjatnikow. *Map, Sections, and Illustrations.* [In Russian; German *résumé.*]

Russia—Siberia—Kamchatka. *B.A. Imp. Sci. St. Petersbourg* (1909): 23–52. **Bianchi.**
Rapport sur une mission scientifique à la Kamtchatka in 1908. Par V. Bianchi. [In Russian.]

Turkey—Asia Minor. **Harris.**
National G. Mag. **19** (1908): 741–760, 833–858; **20** (1908): 1–18.
The Buried Cities of Asia Minor. By Ernest L. Harris. *Illustrations.*

AFRICA.

Bechuanaland—Phytogeography. *Kew B.* (1909): 81–146. **Lugard and Brown.**
The flora of Ngamiland. Introduction, by Major E. J. Lugard; list of plants, by N. E. Brown. *Sketch-map.*

Belgian Congo—Boundary. *Mouvement G.* **26** (1909): 231–232. ——
La frontière du Congo belge dans le Stanley-Pool.

Belgian Congo—Waterways. **Baudon.**
Congrès, Alliance française et S.G., Marseille, 1906 (1908): 250–267.
De l'amélioration de la navigation dans le bassin du Congo-Oubangui. Par A. Baudon.

East Africa Protectorate. ——
East Africa Protectorate. Report for 1907–08; with Returns of Concessions granted for the period January 1, 1908, to June 30, 1908. Colonial Reports, Annual No. 592. 1908. Size 9½ × 6, pp. 48. *Price* 2½*d.*

Egypt—Climate. *Cairo Sc. J.* **3** (1909): 7–10. **Keeling.**
Climate Changes in Egypt. By B. F. E. Keeling. *Diagram.*
See note in the Monthly Record (August, p. 212).

Egypt—Suez Canal. *Ann. Hydrographie* **36** (1908): 349–352. ——
Höhe, Richtung und Geschwindigkeit der Strömungen im Suezkanal. *Diagrams.*

French Congo—Alima. **Courboin.**
B.S.R.G. Anvers **28** (1904): 273–308; **32** (1909): 649–670.
Les populations de l'Alima, Congo Français. Par Albert Courboin. *Illustrations.*

Italian Somaliland—Coast. *Ann. Idrografici* **5** (1908): 9–11. **Fenile.**
Rilievi della R. Nave "Governolo" ad Uarscheik e Itala. Del Com. A. di Fenile.

Madagascar—Historical. *T'oung Pao*, Ser. II., **10** (1909): 1–16. **Ferrand.**
Le pays de Mangalor et de Mangatsini. Par Gabriel Ferrand.
These countries, whence migration to Madagascar in about the tenth century A.D. is said to have taken place, are placed in the Malay peninsula and Sumatra.

Nigeria—Northern. **Parsons.**
Arrows and arrow-wounds in Northern Nigeria. By Allan C. Parsons. (Reprint from the *British Medical Journal*, January 23, 1909.) London, 1909. Size 8½ × 5½, pp. 6.

Nigeria—Northern. ——
Northern Nigeria. Report for 1907–08. Colonial Reports, Annual No. 594. 1909. Size 9½ × 6, pp. 82. *Map. Price* 11*d.*

Réunion—Historical. ——
Isle de Bourbon (Réunion). Documents, 1701–1710. Reprinted from the original manuscripts in the New York Public Library. (Reprinted from the *Bulletin of the New York Public Library*, January, 1909.) New York, 1909. Size 10½ × 7, pp. 57.
The documents relate to the governorship of J. B. de Villers.

Rhodesia—Archæology. *B.S.G. Italiana* **9** (1908): 1251–1283. **Albertis.**
Una gita alle rovine di Zimbàbui. Note di viaggio del cap. Enrico d'Albertis. *Plan and Illustrations.*

Sahara—Menakeb. *B.S.G. Oran* **29** (1909): 21–30. **Priou.**
Reconnaissance du Menakeb. Par — Priou. *Sketch-map.*
Menakeb lies in the little-known part of the desert west of Tuat.

Senegal. *La G., B.S.G. Paris* **18** (1908): 297–314. **Guy.**
Le Sine-Saloum. Par Camille Guy.
A regional study.

South Africa—Astronomy and Surveys. ——
Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the years 1906 and 1907. London, 1908. Size 13 × 8, pp. 12.

Transvaal—Agriculture. ——
Report of the Transvaal Department of Agriculture, July 1, 1907, to June 30, 1908. Pretoria, 1909. Size 9½ × 6, pp. 288. *Maps and Illustration.*

Tunis—Relief. *Jber. Frankfurter V.G.* **71–72** (1906–08): 5–89. **Bartenstein.**
Grundzüge der Bodenplastik von Tunisien. Von Rudolf Bartenstein. *Map.*

Uganda. **Bell.**
Uganda. Report by the Governor on a tour through the Eastern Province. By H. Hesketh Bell. Colonial Report, Miscellaneous No. 57. 1909. Size 9½ × 6, pp. 20. *Sketch-map. Price* 3½*d.*

Uganda. *Cairo Sci. J.* **2** (1908): 125–131, 190–195, 287–290, 368–372. **Weldon.**
The Egyptian Survey Department Expedition to Uganda. By L. B. Weldon. *Map and Illustrations.*
This expedition was for the object of levelling operations (cf. *Journal*, vol. **32**, p. 85).

Wadai. *B.S.G. Com. Bordeaux* **32** (1909): 8–15, 23–32. **Repoux.**
Le Ouadai. Par Capitaine Repoux.

West Africa. *Z. Ges. E. Berlin* (1909): 122–126. **Frobenius.**
Leo Frobenius' Forschungsreise in das Niger-Gebiet. II.—Bericht über den Verlauf der Reise von Bamaka über Timbuktu nach Togo vom April bis Dezember 1908. Von Leo Frobenius.
Describes the writer's journey from Bamako to Timbuktu and Togo.

NORTH AMERICA.

Alaska. *U.S. Geol. Surv. B.* **358** (1908): pp. 72. **Knopf.**
Geology of the Seward Peninsula Tin Deposits, Alaska. By Adolph Knopf. *Map, Sketch-maps, Diagrams, and Illustrations.*

Alaska—Bogoslov Islands. *National G. Mag.* **20** (1909): 194–199. **Munger.**

A Jack in the Box. An Account of the Strange Performances of the most wonderful Island in the World. By Captain F. M. Munger. *Plan and Illustrations.*

Canada—Historical. **Burpee.**

York Factory to the Blackfeet Country. The Journal of Anthony Hendry, 1754–55. Edited by Lawrence J. Burpee. (From the *Transactions of the Royal Society of Canada*, vol. 1, sec. ii., 3rd series, 1907–08.) Ottawa, 1908. Size 9½ × 6½, pp. 307–364. *Map, Sketch, and Illustrations. Presented by the Author.*

Hendry's Journal, important as the record of the first great journey to the upper Saskatchewan country, is here printed for the first time, with introduction and copious notes.

Canada—Maritime Provinces. **Denys and Ganong.**

The description and natural history of the coasts of North America (Acadia). By Nicolas Denys. Translated and edited . . . by Dr. William F. Ganong. (Publications of the Champlain Society, II.) Toronto, 1908. Size 9½ × 6½, pp. xvi. and 626. *Maps and Illustrations (some facsimile). Purchased.*

Mexico. *National G. Mag.* **18** (1907): 493–519. **Darton.**

Mexico—the Treasure House of the World. By N. H. Darton. *Illustrations.*

Notes on the mineral and other resources.

Mexico—Meteorology. **Moreno y Anda.**

Anales de meteorologia mexicana. Observaciones practicadas en el Observatorio Astronomico Nacional de Tacubaya, y en algunas otras estaciones mexicanas, durante el año de 1897. Recopiladas . . . por M. Moreno y Anda. Mexico, 1909. Size 13 × 9, pp. iv. and 242.

Niagara. **Spencer.**

Spoliation of the Falls of Niagara. By Dr. J. W. Spencer. (From the *Popular Science Monthly*, October, 1908.) Size 9½ × 6½, pp. 289–305. *Sketch-maps and Illustrations.*

See note in the Monthly Record, May, p. 601.

United States—Magnetism. **Bauer.**

[U.S.] Coast and Geodetic Survey. United States magnetic tables and magnetic charts for 1908. By L. A. Bauer. Washington, 1908. Size 11½ × 7½, pp. 154. *Charts and Diagram.*

United States—New York. **Emerson.**

B. American G.S. **40** (1908): 587–612; 726–738; **41** (1909): 3–21.

A Geographic Interpretation of New York City. By F. V. Emerson. *Sketch-maps, Sections, and Diagrams.*

United States—Oregon. **Waring.**

U.S. Geol. Surv. Water-Supply Paper **220** (1908): pp. 86.

Geology and water resources of a portion of South-Central Oregon. By Gerald A. Waring. *Maps, Sections, and Illustrations.*

United States—Population. **U.S. Census Bureau.**

Bureau of the Census: Special Reports. Statistics of cities having a population of over 30,000: 1906. Washington, 1908. Size 11½ × 9, pp. viii. and 350.

CENTRAL AND SOUTHERN AMERICA.

Argentine—Anthropology. **Outes.**

Alfarerías del Noroeste argentino. Por Félix F. Outes. (De los Anales des Museo de La Plata, tomo 1.) Buenos Ayres, 1907. Size 15 × 11, pp. 5–52. *Illustrations.*

Brazil.

Le Brésil: ses richesses naturelles, ses industries. (Extrait de l'ouvrage 'O Brazil . . .' publié par le Service d'Expansion Economique du Brésil.) Tome 1. Paris: Aillaud & Co., 1909. Size 11 × 7½, pp. 404. *Maps, Illustrations, and Diagrams. Presented by the Service d'Expansion Economique, Paris.*

Brazil—São Paulo and Mato Grosso. **Liscoa.**

Estrada de Ferro Noroeste do Brasil: Commissão E. Schnoor. Oeste de S. Paulo: Sul de Mato-Grosso: geologia, industria mineral, clima, vegetação, solo agricola, industria pastoril. Por M. A. Ribeiro Lisboa. Rio de Janeiro, 1909. Size 10½ × 7, pp. iv. and 172. *Maps, Illustrations, and Section. Presented by the Author.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australia—Meteorology. **Lockyer.**

Solar Physics Committee. A discussion of Australian meteorology; being a study of the pressure, rainfall, and river changes, both seasonal and from year to year, together with a comparison of the air movements over Australia with those over South Africa and South America. By Dr. William J. S. Lockyer; under the direction of Sir Norman Lockyer. London: Wyman & Sons, 1909. Size 12 × 9½, pp. viii. and 118. *Sketch-maps and Diagrams. Price 5s. Presented by the Author.*

Clipperton Island. *B.S.G. Comm. Bordeaux* **31** (1908): 245-247. **Fleury.**

L'Ile Clipperton. Par Th. Fleury.

This island has lately been the subject of dispute between France and Mexico.

New Zealand—Survey. ———

New Zealand, 1908. New Zealand Geological Survey Department (Second Annual Report (New Series) of the). Wellington, 1908. Size 13½ × 8½, pp. 39. *Maps, Plans, and Illustrations.*

Victoria—Algæ. *J. Linnean S.* (Botany) **39** (1909): 1-88. **West.**

The Algæ of the Yan Yean Reservoir, Victoria: a Biological and Œcological Study. By G. S. West. *Plan, Charts, and Illustrations.*

POLAR REGIONS.

Antarctic. *G.Z.* **14** (1908): 427-447, 481-499; **15** (1909): 92-110, 146-157. **Mecking.**

Der heutige Stand der Geographie der Antarktis. Von Ludwig Mecking.

Antarctic—Shackleton Expedition. *Nature* **80** (1909): 130-134. **Chree and Dines.**

Lieut. Shackleton's Antarctic Expedition. Explorations and Results. The South Magnetic Pole. By Dr. C. Chree. Meteorological Observations. By W. H. Dines, Biological Results. *Sketch-map.*

Arctic—Franklin Search. **Tyrrell.**

A story of a Franklin search expedition. By J. B. Tyrrell. (From the *Transactions of the Canadian Institute*, vol. **8**, 1908-09.) [Toronto, 1909.] Size 9½ × 6½, pp. 393-402. *Map.*

The expedition referred to is that of Messrs. Anderson and Stewart, sent by Sir G. Simpson to the mouth of the Great Fish river in 1855 (see August number, p. 217).

Arctic Exploration. *Nineteenth Century* **65** (1909): 690-698. **Harrison.**

Sledging as a method of exploring the Arctic Ocean. By Alfred H. Harrison. *Also separate copy.* Size 10 × 6, pp. 10.

Arctic Ocean. **Garde.**

The state of the ice in the Arctic seas, 1908. Prepared by V. Garde. (From the *Nautical-Meteorological Annual of the Danish Meteorological Institute.*) [Copenhagen, 1909.] Size 12 × 9½, pp. 18. *Maps.*

Polar Congress. ———

International Polar Commission; Session of 1908. Proceedings of the meetings. Brussels, 1908. Size 9½ × 6½, pp. 110 and clxii. *Illustrations.*

Spitsbergen—Geology. ———

Missions scientifiques pour la mesure d'un arc de méridien au Spitzberg, entreprises en 1899-1901, sous les auspices des Gouvernements Russe et Suédois. Mission Russe; Tome II., IX^e^ Section, B. Géologie: 2. Observations dans le Spitzberg Central. St. Petersburg, 1908. Size 12½ × 10, pp. 28. *Map and Illustrations.*

Spitsbergen—Historical. *Ymer* **29** (1909): 3-89. **Nathorst and others.**

Swedish explorations in Spitzbergen, 1758-1908. Historical sketch, by A. G. Nathorst; Bibliography, by J. M. Hulth; and List of Maps, by E. de Geer. *Maps and Illustrations. Also separate copy, presented.*

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Cartography. ———

Service Géographique de l'Armée. Rapport sur les travaux exécutés en 1907. Paris, 1908. Size 10 × 6½, pp. 48. *Index-maps.*

Cartography—Map-reading. **Salisbury and Atwood.**

U.S. Geol. Surv., Prof. Paper, No. 60 (1908): pp. 84.

The interpretation of topographic maps. By Rollin D. Salisbury and Wallace W. Atwood. *Maps and Illustrations.*

Position determination. **Ball.**

Altitude tables, computed for intervals of four minutes between the parallels of latitude 24° and 60° and parallels of declination 24° and 60°, designed for the determination of the position line at all hour angles without logarithmic computation. By Frederick Ball. London: J. D. Potter, 1909. Size 9½ × 6, pp. xxxviii., and 314. *Diagrams.* *Price* 15*s. net.* *Presented by the Publishers.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Astronomy—Eclipse. **Lüdeling and Nippoldt.**

Abh. K. Preuss. Met. I. **2** (1908): No. 6, pp. 92.

Die Expedition des K. Preussischen Meteorologischen Instituts nach Burgos in Spanien zur Beobachtung der totalen Sonnenfinsternis am 30. August 1905. Von G. Lüdeling und A. Nippoldt. *Maps, Diagrams, and Illustrations.*

Includes reports on the magnetic and meteorological observations.

Climatology. **Telles.**

IX^e^ Congrès International de Géographie; Genève, 1908. Le régionalisme climatologique. Par le Dr. Silva Telles. Lisbon, 1908. Size 8½ × 6, pp. 8.

Climatology—Temperature. *Ann. Hydrographie* **36** (1908): 333–348. **Grossmann.**

Die Beziehung zwischen den Temperaturen des Nordatlantischen Ozeans und von Nordwest- und Mitteleuropa. Von Prof. Grossmann. *Diagrams.*

Earthquakes—Surface Changes. *G.Z.* **15** (1909): 65–80. **Sapper.**

Erdbeben und Erdoberfläche. Von Karl Sapper.

Discusses the surface changes resulting from earthquakes.

Geomorphology—Erosion. *J. Geology* **16** (1908): 746–754. **Fenneman.**

Some features of erosion by unconcentrated wash. By N. M. Fenneman.

Glaciers. *Z. Gletscherkunde* **3** (1909): 161–185. **Brückner and Muret.**

Les variations périodiques des glaciers. XIII^e^ rapport, 1907. Rédigé . . . par Dr. Ed. Brückner et E. Muret.

Limnology—Plankton. *Ymer* **29** (1909): 90–133. **Wesenberg.**

Grundtrækkene i Ferskvandsplanktonets Biologi og Geografi. Af C. Wesenberg. *Illustrations.*

Meteorology—Precipitation. **Hellmann.**

Abh. K. Preuss. Met. I. **3** (1909): pp. 82 and xxviii.

Untersuchungen über die Schwankungen der Niederschläge. Von G. Hellmann. *Maps and Diagrams.*

Meteorology—Temperature. **Fritsche.**

Die mittlere Temperatur der Luft im Meeresniveau, dargestellt als Funktion der geographischen Länge, Breite und Jahreszeit von Dr. H. Fritsche. Riga, 1909. Size 10½ × 6½, pp. 144. [Reproduction of manuscript.] *Sketch-maps. Presented by the Author.*

Oceanography—Atlantic. ——

Report on Norwegian Fishery and Marine Investigations, vol. **2** (1909), No. 1. Review of Norwegian Fishery and Marine Investigations, 1900–1908. [Christiania, 1909.] Size 10½ × 7½, pp. 1–204. *Sketch-maps and Illustrations.*

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Ethnology. *Smithsonian Rept.* 1907 (1908): 497–521. **Fischer.**

The Mediterranean Peoples. By Theobald Fischer.

Among other results of his study, the author records the fact that one-third of all the inhabitants of the coast-countries of the Mediterranean are of one race—the Italian.

History of Cartography. **Teleki.**

Utilisation des données fournies par les cartes marines ibériques dans les ateliers cartographiques de Hollande. Par le Comte Paul Teleki. (Extrait de l'ouvrage "Atlas zur Geschichte der Kartographie der Japanischen Inseln.") (From the 'Revue de Hongroie,' Tome III., No. 2; Budapest, etc., 15 Février, 1909.) Size 9½ × 6½, pp. 210–224. *Facsimile Map.*

History of Geography. *G.Z.* **15** (1909): 12–28. **Kiessling.**

Varenius und Eratosthenes. Von M. Kiessling.

In part a review of Günther's work on Varenius, in part an independent discussion of the influences to which that geographer was subject; a foremost place being given to Eratosthenes.

BIOGRAPHY.

Habenicht. *G. Anzeiger* **10** (1909): 77–79. **Haack.**

Hermann Habenicht als Kartograph, 1859–1909. Von Dr. Hermann Haack. *Portrait.*

La Sale. *Acta S. Sc. Fennicæ* **33** (1908): No. 1, pp. 152. **Söderhjelm.**

Notes sur Antoine de La Sale et ses œuvres. Par Werner Söderhjelm.

This fifteenth-century writer is known to geographers as the author of 'La Salade,' which included a geographical description of the world.

Oberhummer. *Deutsche Rundschau G.* **31** (1908): 133–136. ——

Prof. Eugen Oberhummer. *Portrait.*

GENERAL.

Dictionary. **Meycliar.**

English-Russian and Russian-English Engineering dictionary; embracing terms relating to mechanical and marine engineering and naval architecture. By Leo Meycliar. London: E. & F. N. Spon, [1909]. Size $6\frac{1}{2} \times 4$, pp. 96. *Price 2s. 6d. net. Presented by the Publishers.*

Education. *G.Z.* **15** (1909): 129–146. **Bruhns.**

Die besondere Aufgabe des geographischen Lehrbuches neben dem Atlas und den Anschauungsmitteln. Von B. Bruhns.

Education. *Z. Ges. E. Berlin* (1909): 173–183. **Fox.**

Reformbestrebungen und Erdkunde an den höheren Lehranstalten. Von Dr. Robert Fox.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

Austria. **Freytag and Kordon.**

Karte der Goldberg- und Ankogelgruppe. Bearbeitet von Gustav Freytag mit Beiträgen von F. Kordon. Scale 1: 50,000 or 1·3 inch to 1 stat. mile. Vienna: G. Freytag & Berndt, 1909. *Price* 2.50*m. Presented by the Publisher.*

A revised edition of a useful tourist map of this interesting region, showing the new railway and tunnel under the Gamskarl. Contours are drawn at 100-metre intervals over vertical hachuring, and altogether the relief is well indicated. A smaller-scale general map of the district and its surroundings is added.

Balkan Peninsula. **Trzebitzky.**

Die Niederschlagsverteilung auf der südeuropaischen Halbinsel. Von Franz Trzebitzky. Scale 1: 3,700,000 or 1 inch to 58·4 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 21. Gotha: Justus Perthes, 1909. *Presented by the Publisher.*

British Isles. **Mackinder.**

Stanford's new orographical map of the British Isles. Compiled under the direction of H. J. Mackinder, M.A. Scale 1: 728,640 or 1 inch to 11·5 stat. miles. 4 sheets. London: Edward Stanford, 1909. *Price* 16*s. Presented by the Publishers.*

This forms one of the series of Stanford's orographical maps now in course of publication. In style of production it resembles that of the others of the same series which have been previously noticed in the *Geographical Journal.*

British Isles. **Repington and Fisher.**

Distribution map of the Military Forces in the British Isles. Prepared under the direction of Lieut.-Colonel C. à Court Repington, C.M.G., by Percy Fisher. With tables showing the composition of the Regular and Territorial Field Armies

and the Troops allotted to Coast Defence. Scale 1 : 633,600 or 1 inch to 10 stat. miles. 4 sheets. London : Sifton, Praed & Co., Ltd., 1909. *Price 7s. 6d. Presented by the Publishers.*

A boldly drawn diagrammatic map of the British Isles upon which the distribution of the military forces is shown by various clearly defined symbols, the location of the forces of the regular army being indicated in red, and that of the territorials in blue. The map ought to be of considerable interest, specially at the present time when so much attention is turned to these matters.

British Isles—England and Wales. **Ordnance Survey**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from July 1 to 31, 1909.

1-inch (third edition) :—

In outline, 145, 159, 181, 182, 215, 308. 1*s. each* (engraved).

Large-sheet series, printed in colours, and folded in cover or flat in sheets, 77, 83. *Price, on paper,* 1*s.* 6*d.*; *mounted on linen,* 2*s.*; *mounted in sections,* 2*s.* 6*d. each*

6-inch—County Maps :—

Hampshire (Second Revision), 5 sheets. **Kent** (Second Revision), 13 sheets. **Lancashire** (First Revision of 1891 Survey), 4 sheets. **Yorkshire** (First Revision of 1891 Survey), 5 sheets. 1*s. each.*

1 : 2500 Scale—County Maps :—

Cheshire (Second Revision), 44 sheets. **Hampshire** (Second Revision), 10 sheets. **Kent** (Second Revision), 12 sheets. **Lancashire** (First Revision of 1891 Survey), 5 sheets. **Sussex** (Second Revision), 15 sheets. **Yorkshire** (First Revision of 1891 Survey), 47 sheets.

E. Stanford, London Agent.

British Isles—England and Wales. **Geological Survey.**

1-inch map.

New Series, colour printed. Drift Edition, 63, 71. 1*s.* 6*d. each.*

6-inch map.

Quarter-sheets, uncoloured. Carmarthen, 10 sheets. Glamorgan, 2 sheets.

(*E. Stanford, London Agent.*)

Europe. **Tarride.**

Carte Routière de l'Allemagne du Sud, Autriche, Tyrol. Scale 1 : 900,000 or 1 inch to 14·2 stat. miles. Paris : A. Tarride, [1909].

France. **Ministre de l'Intérieur, Paris.**

Carte de la France dressée par ordre du Ministre de l'Intérieur. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets : xi.–22, Parthenay ; xv.–37, Foix ; xvi.–6, St. Omer ; xvii.–21, Dun-sur-Auron ; xviii.–7, Douai ; xviii.–27, St. Germain-Lembron ; xviii.–35, Béziers ; xix.–9, Guise ; xix.–24, Lapalisse ; xxii.–10, Sedan. Paris : Hachette & Cie., 1909. *Price* 0.80 *fr. each sheet.*

These are new editions.

Germany. **K. Preuss. Landesaufnahme.**

Karte des Deutschen Reiches. Scale 1 : 100,000 or 1 inch to 1·6 stat. miles. Sheets : (Kupferdruckausgabe) 390, Leipzig ; 420, Görlitz ; 439, Jena ; 466, Rudolstadt. (Buntdruckausgabe) 363, Eisleben. (Umdruckausgabe) 390, Leipzig ; 420, Görlitz. Berlin : R. Eisenschmidt, 1908–09. *Price* 1.50*m. each sheet.*

Holland. **Taride.**

Grande Carte Routière de la Hollande à l'usage des Automobiles, Cyclistes, Touristes, etc. Scale 1 : 400,000 or 1 inch to 6·3 stat. miles. Paris : A. Taride, [1909].

Hungary—Transylvania. **Mazere.**

Harta Etnografica a Transilvaniei de Prof. Nicolae Mazere. Scale 1 : 340,000 or 1 inch to 5·3 stat. miles. Jassy : Institutul Geografic al Armatei, 1909. *Presented by the Author.*

Servia. **General Staff, Belgrade.**

General map of the Kingdom of Servia. [In Servian.] Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. 9 sheets. Belgrade : General Staff, 1906.

Spain and Portugal. **Tarride.**

Espagne et Portugal à l'usage des Cyclistes, Automobiles, Touristes, etc. Scale 1 : 1,400,000 or 1 inch to 22·1 stat. miles. Paris : A. Tarride, [1909].

ASIA.

Asia Minor. **Diest.**

Itinerar von Nysa nach Idyma. Aufgenommen von Oberst v. Diest, 1907. Scale 1 : 200,000 or 1 inch to 3·2 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 19. Staat-Lage und Umgegend von Nysa. Aufgenommen von Oberst v. Diest, Mai 1907. Scale 1 : 7,500 or 8·4 inches to 1 stat. mile. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 20. Gotha : Justus Perthes, 1909. *Presented by the Publishers.*

China. **China Inland Mission.**

A map of China prepared for the China Inland Mission. Scale 1 : 3,000,000 or 1 inch to 47·3 stat. miles. Two sheets. London : Edward Stanford, 1909. *Price* 12*s.* 6*d.* *Presented by the China Inland Mission.*

A good general map of China, drawn chiefly from the sheets of the atlas of the Chinese Empire recently prepared at Mr. Stanford's establishment for the China Inland Mission, and which was noticed in the *Geographical Journal* for November last. Roads, railways, canals, and telegraph stations are clearly shown, and much other useful information indicated. The relative importance of each city and town is shown by symbols and by the type in which its name is written. No hill shading appears on the map, but a few heights of the land are given in figures.

China. **K. Preuss. Landesaufnahme.**

Karte von Ost-China. Herausgegeben von der Kartographische Abteilung der Königl. Preuss. Landesaufnahme. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. Sheets : Mukden ; Peking. Berlin : R. Eisenschmidt, 1909.

India. **Heins.**

Volksdichte im nordwestlichen Indien. Auf Grund der indischen Zählung 1901 zusammengestellt und bearbeitet von H. Heins. Scale 1 : 3,000,000 or 1 inch to 47·3 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 18. Gotha : Justus Perthes, 1909. *Presented by the Publisher.*

Indian Government Surveys. **Surveyor-General of India.**

India and adjacent countries, 1 : 1,000,000, 4 sheets. Afghanistan, Baluchistan, Bengal, Persia ; 1 inch to 1 mile, North-West Frontier Province, 3 sheets ; Central India Agency, 2 sheets ; Berar, 1 sheet ; Central Provinces and Berar, 2 sheets ; United Provinces, 1 sheet ; Bengal, 3 sheets ; Burma, 13 sheets.—North-Western Trans-Frontier, 1 inch to 4 miles, 3 sheets.—North-Eastern Frontier, 1 inch to 8 miles, 1 sheet.—Bengal : Presidency Division, 1 inch to 8 miles ; Bengal Survey, 1 inch to 1 mile, 15 sheets.—Bombay Survey, 1 inch to 1 mile, 8 sheets ; Sind Survey, 1 inch to 1 mile, 1 sheet.—Burma Survey, 1 inch to 1 mile, 2 sheets.—Central India and Rajputana Survey, 1 inch to 1 mile, 5 sheets.—Central Provinces, 1 inch to 32 miles ; Central Provinces Survey, 1 inch to 1 mile, 1 sheet.—Eastern Bengal and Assam : Bogra District, 1 inch to 4 miles ; Malda District, 1 inch to 4 miles ; Eastern Bengal and Assam Survey, 1 inch to 1 mile, 2 sheets.—Hyderabad (State), 1 inch to 32 miles.—Madras Presidency and Mysore, 1 inch to 16 miles ; Mysore and Coorg, 1 inch to 16 miles.—Punjab Survey, 1 inch to 1 mile, 5 sheets.—United Provinces : United Provinces, 1 inch to 32 miles ; Azamgarh District, 1 inch to 4 miles ; United Provinces Survey, 1 inch to 1 mile, 10 sheets. Calcutta : Surveyor-General's Office, 1909. *Presented by the Secretary of State for India, through the India Office.*

Tibet. **Zugmayer.**

Dr. Erich Zugmayers Reiseweg in Nordwest-Tibet, Juni bis September, 1906. Scale 1 : 1,000,000 or 1 inch to 15·8 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 17. Gotha : Justus Perthes, 1909. *Presented by the Publishers.*

AFRICA.

Africa. **Survey Department, Cairo.**

Physical school map of Africa. [In Arabic.] Scale 1 : 6,000,000 or 1 inch to 94·5 stat. miles. 6 sheets. Cairo : Survey Department, 1909. *Presented by the Director-General, Survey Department, Cairo.*

A boldly executed orographical wall-map of Africa, with lettering in Arabic, prepared

by the Survey Department, Cairo, for use of Egyptian schools. The land relief is shown by tints of brown over vertical hachuring, and the depths of the water by different shades of blue. The six sheets when joined together form a map which measures 70 inches by 65 inches. An inset is given in the south-west corner, showing political divisions and boundaries.

Egypt. **Baraize.**

Service des Antiquités de l'Egypte. Plan des Nécropoles Thébaines levé par M. E. Baraize. Troisième Livraison (Feuilles 8, 30, 41, 59, et 60). Scale 1 : 500 or 126·7 inches to 1 stat. mile. Cairo: General Survey Printing Office. Leipzig: K. W. Hiersemann, 1907.

Egypt. **Survey Department, Cairo.**

Map of Egypt. Scale: 1 : 50,000 or 1·3 inch to 1 stat. mile. Sheets: N.E. VI.–V., Mataria; VII.–III., Faraskur; VIII.–I., Baltim. Cairo: Survey Department, 1909. *Presented by the Director-General, Survey Department, Cairo.*

Egypt. **Survey Department, Cairo.**

Physical school map of Egypt. [In Arabic.] Scale 1 : 750,000 or 1 inch to 11·8 stat. miles. 6 sheets. Cairo: Survey Department, 1909. *Presented by the Director-General, Survey Department, Cairo.*

A general wall-map prepared by the Survey Department, Cairo, for the use of Egyptian schools. It is boldly drawn and printed in colour. Lettering is in Arabic. The Sudan is not included, but a small general map of Egypt and the Sudan is given as an inset. The six sheets can be mounted as one, so forming a map measuring 66 inches by 66 inches.

French Guinea. **Meunier.**

Ministère des Colonies-Service. Géographique et des Missions. Carte de la Guinée Française. Dressée par A. Meunier. 2e Edition, 1909. Scale 1 : 500,000 or 1 inch to 7·9 stat. miles. Sheets: 2, Kouroussa; 3, Konakry. Paris: Service Géographique des Colonies, 1909. *Presented by M. J. Forest, Paris.*

French West Africa. **Meunier and Barralier.**

Ministère des Colonies. Service Géographique et des Missions. Carte de l'Afrique Occidentale Française. Dressée par A. Meunier et E. Barralier d'après les documents les plus récents. 2e Edition, 1908. Scale 1 : 2,000,000 or 1 inch to 31·6 stat. miles. Sheets: 1, Dakar; 4, Konakry. Paris: Service Géographique des Colonies, 1908. *Price 1.50 fr. each sheet. Presented by M. J. Forest, Paris.*

West Africa. **Service Géographique de l'Afrique Occidentale Française.**

Carte de l'Afrique Occidentale Française. Scale 1 : 1,500,000 or 1 inch to 23·6 stat. miles. Sheet 1 (2nd edition), Sénégal, Mauritanie, partie occidentale du Haut-Sénégal et Niger. Paris: Service Géographique du Government de l'Afrique Occidentale Française, 1909. *Price 2.50 fr. each sheet.*

AMERICA.

Canada. **Department of Militia and Defence, Ottawa.**

Topographic map of Canada. Scale 1 : 63,360 or 1 inch to 1 stat. mile. Ontario. Sheets: 18, Alexandria; 19, Thurso; 20, Hawkesbury. Ottawa: Department of Militia and Defence. London: Geographical Section, General Staff, War Office, 1909. *Presented by the Director of Military Operations.*

These sheets form part of the topographical map in course of preparation by the Department of Militia and Defence of Canada, which was first noticed in the *Geographical Journal* for April, 1907. The natural features of the country are clearly shown, the relief being in brown contours at 25-feet intervals and figures, forests green, water blue. The character of all roads, railways and bridges is well distinguished, and much other useful information given by means of symbols, a full explanation of which appears on the margin of each sheet. Altogether these sheets form good examples of topographical mapping, and indicate clearly the great improvement that has taken place in recent years in the production of such maps.

Canada—Nova Scotia. **Canadian Geological Survey.**

Geological Survey of Canada. Scale 1 : 63,360 or 1 inch to 1 stat. mile. Province of Nova Scotia. Sheets: 39, Tangier; 40, Sheet Harbour; 41, Fifteen-mile stream; 49, Upper Musquodoboit; 50, Moose river; 51 (and 52), Ship harbour; 53, Lawrencetown; 54, Musquodoboit harbour; 55, Gay river; 66, Elmsdale; 67,

Waverley; 68, City of Halifax; 69, Prospect; 70, Aspotogan; 71, St. Margaret bay; 73, Windsor; 100 (and 101), Apple river. Ottawa: Geological Survey of Canada, 1894–1909. *Presented by the Geological Survey of Canada.*

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during June, 1909. *Presented by the Hydrographer, Admiralty.*

New Charts.—No. X18, Diagram of characteristics of lights shown on Admiralty charts, 2*s*. 3718, Scotland, west coast: Sound of Mull, western portion, 3*s*. 3736, Africa, west coast. Plans in Liberia: Cestos bay, 3*s*. 3726, Eastern archipelago. Bali strait and plans of Banjuwangi, Chupel, Pulukan roads, and Pantai Barat, 3*s*. 3728, Borneo: Marudu bay. Plans: Marudu river and Tanjong Batu anchorages, Cutch Factory anchorage, 3*s*. 3727, Plans in the Gulf of Siam: Koh Pra anchorage and approaches, Riem bay, 3*s*. 3731, Society Islands, Tahiti: Papiete harbour, 2*s*.—**New Plans and Plans added.** 2113, Plans of anchorages on the west coast of Sicily. Plan added: Port Empedocle, 2*s*. 2853, Gulf of Mexico, Mississippi sound, and Mobile bay. Plan added: Ship island bar. New Plan: Horn island pass, 3*s*. 2737, India, west coast, Viziadrug to Cochin. Plans added: Kalpeni island, Androth island, 3*s*. 2468, Plans of anchorages in Sumba, Timor, etc. Plans added: South anchorage (*Liran island*). Sagu bay, 2*s*. 1460, Ports in Arafura sea. New Plan: Dilhi harbour, 2*s*. 764, New Hanover, New Ireland and New Britain. Plans added: Adler bay, Eber bay, 2*s*.

Atlantic, North. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic ocean, July, 1909. Washington: U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

Atlantic, North. **U.S. Weather Bureau.**

Meteorological chart of the North Atlantic Ocean, September, 1909. Washington: Department of Agriculture, U.S. Weather Bureau, 1909. *Presented by the U.S. Weather Bureau.*

Atlantic, North, and Mediterranean. **Meteorological Office.**

Monthly meteorological charts of the North Atlantic and Mediterranean, August, 1909. London: Meteorological Office, 1909. *Price 6d. each. Presented by the Meteorological Office.*

Atlantic, South. **U.S. Weather Bureau.**

Meteorological chart of the South Atlantic ocean, Season—September, October, November, 1909. Washington: Department of Agriculture, U.S. Weather Bureau, 1909. *Presented by the U.S. Weather Bureau.*

Indian Ocean and Red Sea. **Meteorological Office.**

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, August, 1909. London: Meteorological Office, 1909. *Price 6d. each. Presented by the Meteorological Office.*

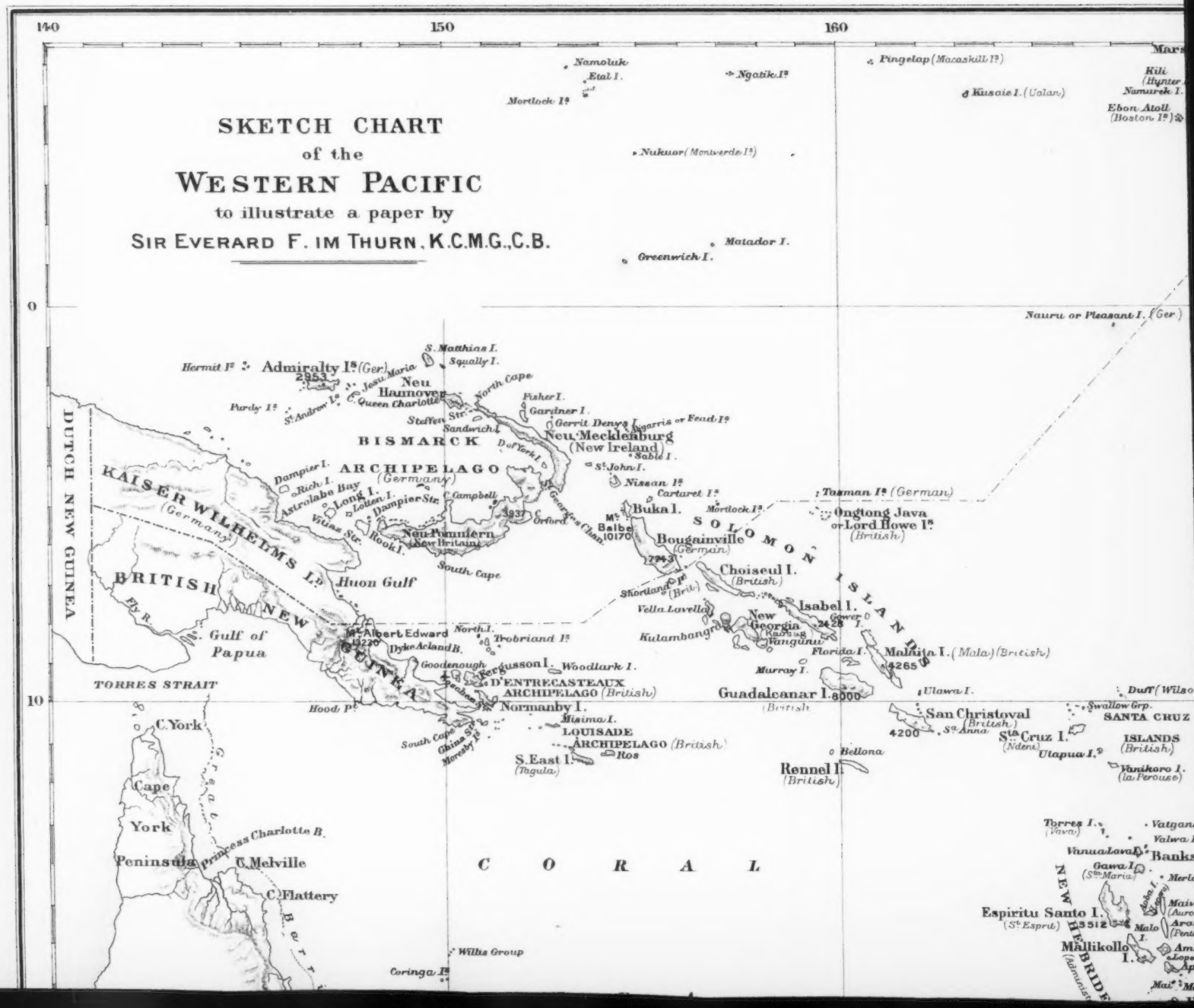
Pacific, North. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, August, 1909. Washington: U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

Pacific, North. **U.S. Weather Bureau.**

Meteorological chart of the North Pacific Ocean, September, 1909. Washington: Department of Agriculture, U.S. Weather Bureau, 1909. *Presented by the U.S. Weather Bureau.*

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.


SKETCH CHART
of the
WESTERN PACIFIC
to illustrate a paper by
SIR EVERARD F. IM THURN, K.C.M.G., C.B.
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Namoluk
Etal I.
Mortlock Is
Ngatik Is
Pingelap (Macaskill Is)
Kusaie I. (Ualan)
Kili (Bikini)
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Ebon Atoll (Boston Is)
Nukuor (Monverde Is)
Matador I.
Greenwich I.
Nauru or Pleasant I. (Ger.)
Admiralty Is (Ger.)
2953
Hermit Is
Jesu Maria
Queen Charlotte
Purdy Is
St. Andrew Is
S. Matthias I.
Squally I.
Neu Hannover
North Cape
Fisher I.
Gardner I.
Steffen Str.
Sandwich I.
Gerrit Denys I.
Nggarris or Feni Is
BISMARCK ARCHIPELAGO (Germany)
Neu Mecklenburg (New Ireland)
D'Urville I.
Sable I.
St. John I.
Nissan Is
Cartaret Is
Tasman Is (German)
Ongtong Java or Lord Howe Is (British)
Dampier I.
Rich I.
Astrolabe Bay
Long I.
Lolen I.
Dampier Str.
C. Campbell
Vitiaz Str.
Rook I.
Neu Pommern (New Britain)
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George's Chan.
Buka I.
Mortlock Is
Balbi
10170
Bougainville (German)
7243
SOLOMON ISLANDS
Choiseul I. (British)
Shortland Is (Brit.)
Vella Lavella
Isabel I.
Gower I.
New Georgia
2428
Kulambangra
Vanguna
Florida I.
Malaita I. (Mala) (British)
6265
Murray I.
Guadalcanar I. 8000
(British)
Ulawa I.
Duff (Wilson)
Swallow Grp.
SANTA CRUZ ISLANDS (British)
San Christoval (British)
4200
Sa Anna
Sta Cruz I. (Ndeni)
Utupua I.
Vanikoro I. (la Perouse)
Bellona
Rennel I. (British)
DUTCH NEW GUINEA
KAISER WILHELMS L. (Germany)
BRITISH NEW GUINEA
Huon Gulf
Fly R.
Gulf of Papua
Mt. Albert Edward
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North I.
Trobriand Is
Dyke Acland B.
Goodenough
Fergusson I.
Woodlark I.
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Normanby I.
Misima I.
LOUISADE ARCHIPELAGO (British)
Ros
S. East I. (Tagula)
South Cape
Ghiss I.
Moresby Is
C. York
Cape York Peninsula
Princess Charlotte B.
C. Melville
C. Flattery
Great Barrier Reef
C O R A L
Willis Group
Coringa Is
Torres I. (Vava)
Vatgana
Valwa I.
Vanua Lava I.
Banks
Gaua I. (S. Maria)
Merlav
Maiva (Aurora)
Espiritu Santo I.
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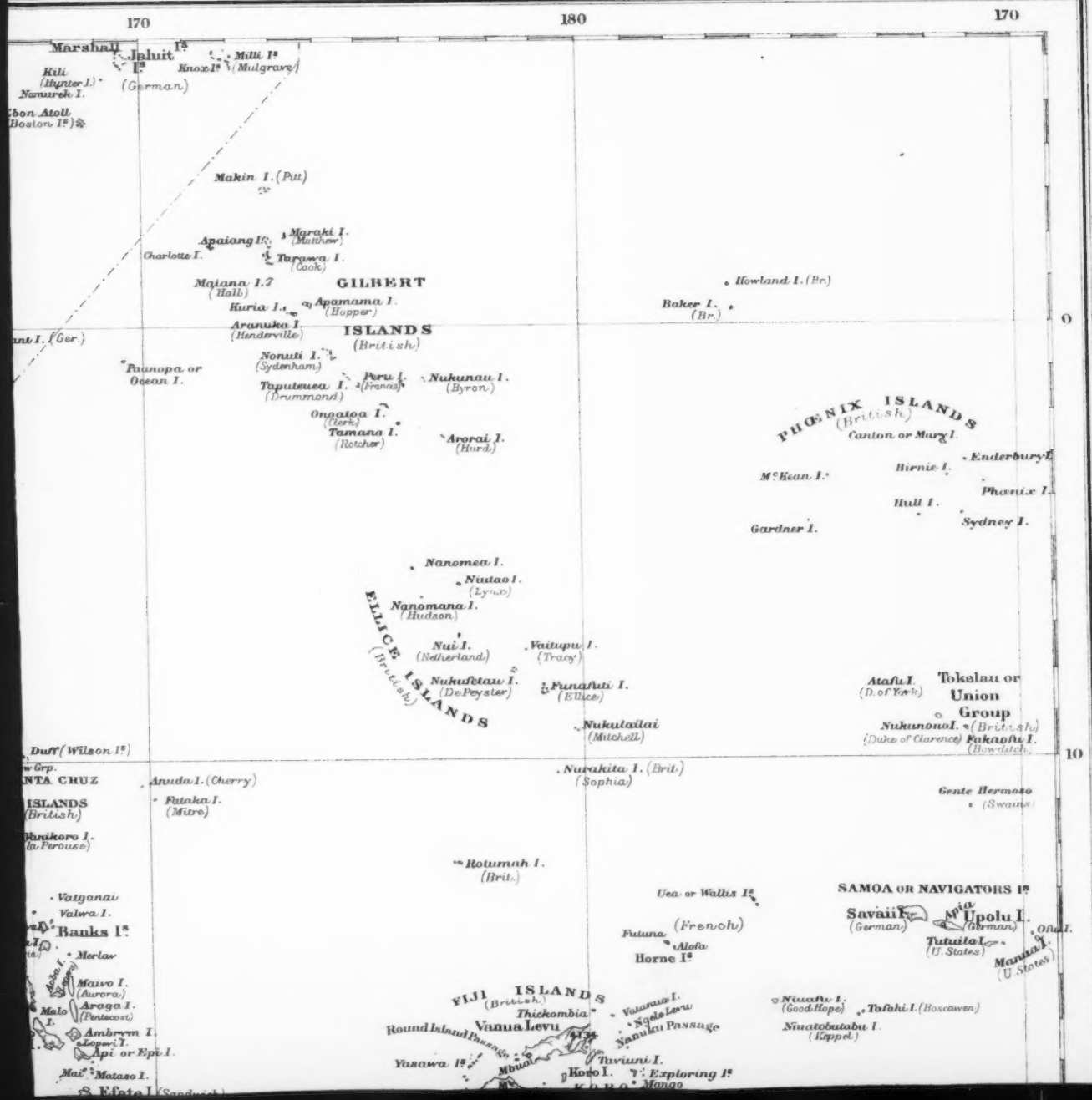
NEW HEBRIDES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Charlotte I.
Tarawa I. (Cook)
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(Hall)
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Apamama I. (Hopper)
Aranuka I. (Henderville)
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Birnie I.
McKean I.
Phoenix I.
Hull I.
Sydney I.
Gardner I.
Nanomea I.
Niutao I. (Lyne)
Nanomana I. (Hudson)
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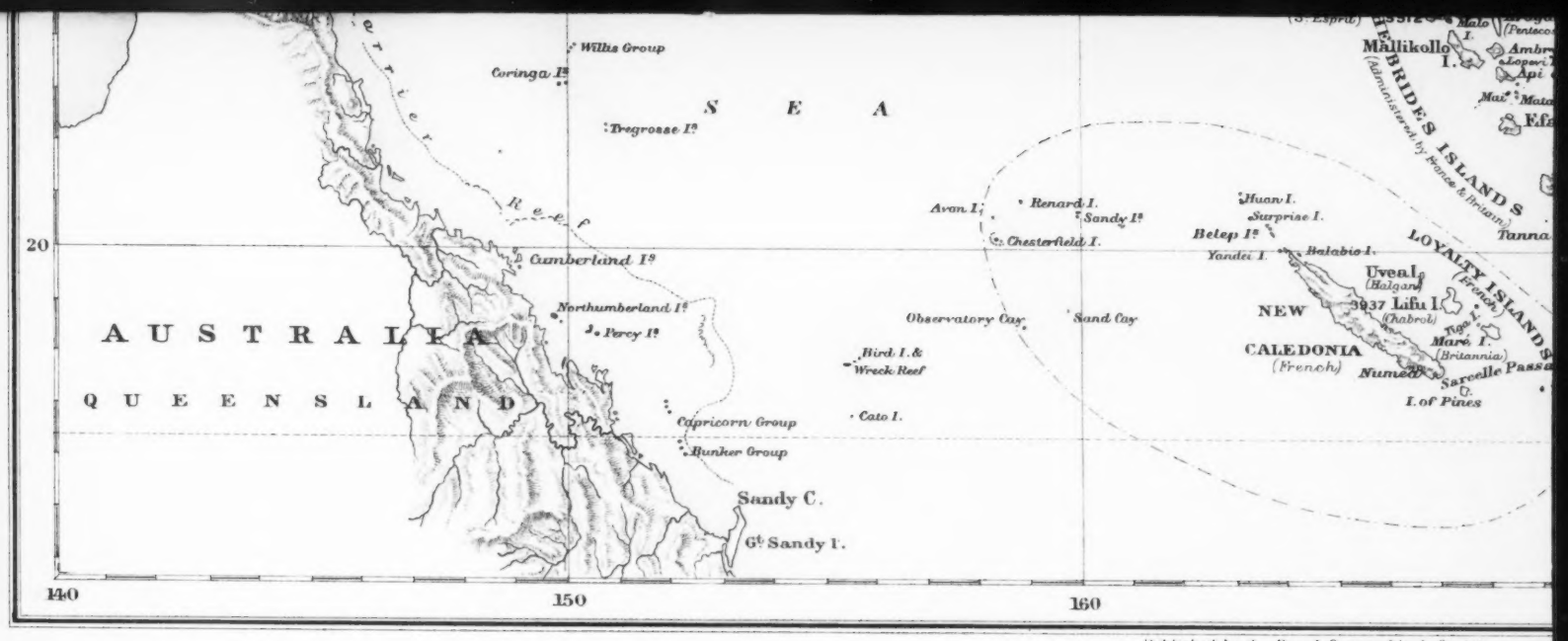
Vaitupu I. (Tracy)
Nukufetau I. (De Peyster)
Funafuti I. (Ellice)
Nukulailai (Mitchell)
Atafu I. (D. of York)
Tokelau or Union Group
Nukunonu I. (British) (Duke of Clarence)
Fakaofu I. (Bowditch)
10
Duff (Wilson Is)
Nurakita I. (Brit.) (Sophia)
Gente Hermoso (Swains)
Anuda I. (Cherry)
Futaka I. (Mitre)
Rotumah I. (Brit.)
Uea or Wallis Is
Samoa or Navigators Is
Savaii I. (German)
Apia
Upolu I. (German)
Tutuila I. (U. States)
Manua I. (U. States)
Futuna (French)
Alofa
Horne Is
Fiji Islands
(British)
Thickombia
Vanua Levu
Round Island Passage
Yasawa Is
Vatuana I.
Ngele Levu
Nanuku Passage
Tuvuni I.
Koro I.
Exploring Is
Mango
Niuafu I. (Good Hope)
Tafahi I. (Boscawen)
Niuatobutabu I. (Keppel)
Vatganai
Valwa I.
Banks Is
Merlav
Mavo I. (Aurora)
Araga I. (Pentecost)
Ambrym I.
Lopevi I.
Api or Epi I.
Malo I.
Mai
Matazo I.
Efate I.
Santa Cruz Grp.
Santa Cruz Islands
(British)
Vanikoro I. (La Perouse)



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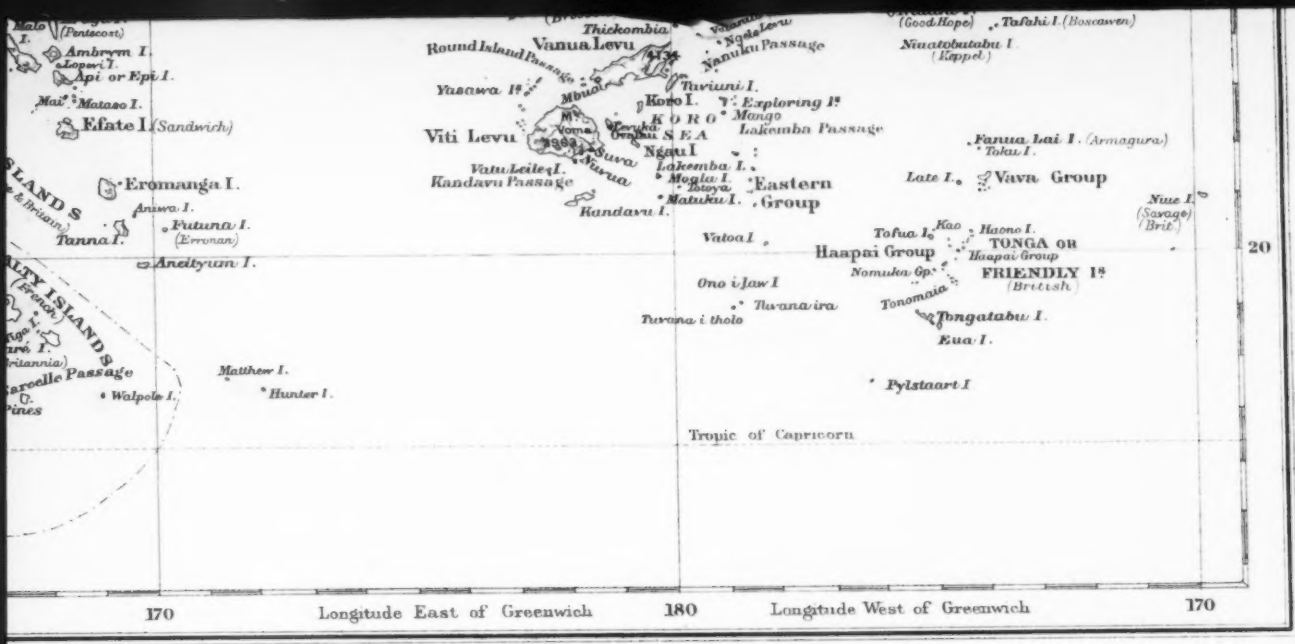
Thickombia
Vanua Levu
Round Island Passage
Yasawa Is
Mbuai
Tuviuni I.
Koro I.
Exploring Is
KORO SEA
Mango
Lakemba Passage
Viti Levu
Suva
Ngau I
Lakemba I.
Mogia I.
Batoya
Matuku I.
Eastern Group
Vatu Leile I.
Kandavu Passage
Kandavu I.
Ngele Levu
Nanuku Passage
(Good Hope)
Tafahi I. (Boscawen)
Niuatobutabu I. (Keppel)
Fanua Lai I. (Armagura)
Toku I.
Late I.
Vava Group
Niue I. (Savage) (Brit.)
Vatoa I.
Tofua I.
Kao
Haono I.
Haapai Group
TONGA OR FRIENDLY Is (British)
Nomuka Gp.
Ono i Jaw I
Tuvana ira
Tonomaia
Tongatabu I.
Eua I.
Turvana i thole
Pylstaart I
Tropic of Capricorn
Malo I.
(Pentecost)
Ambrym I.
Lopevi I.
Api or Epi I.
Mai
Mataso I.
Efate I. (Sandwich)
Eromanga I.
Aniwa I.
Futuna I. (Erroman)
Tanna I.
Aneityum I.
Matthew I.
Hunter I.
Walpole I.
Longitude East of Greenwich
Longitude West of Greenwich
170
180
170
20

ociety.